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RAWSON'S

ARITHMETIC,

WITH KEY, 3s. 6d.

EXERCISES

IN

ARITHMETIC,

FOR THE USE OF SCHOOLS,

ARTIZANS, AND OTHERS.

BY

ROBERT RAWSON,

Head Master of the Dockyard School, Portsmouth; Honorary Member of the Manchester Literary and Philosophical Society.

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TO THE HON. W. COWPER, M.P.

SIR,

MY sense of the warm interest which you have invariably manifested in the promotion of education, and of your kind encouragement accorded to myself in the discharge of my duties, as a teacher, prompts me most respectfully to inscribe to you the following pages. With an earnest hope that they may be useful, in facilitating the acquisition of a subordinate, but very important, branch of mathematical science,

I have the honor to be,
Sir,
Your most obedient humble servant,

ROBERT RAWSON.

PREFACE.

THE object aimed at in this work is to supply a series of questions illustrative of the rules of Arithmetic.

The questions, consisting of nearly three thousand, are entirely new, and are arranged in convenient sections, with a view to facilitate the labour of the teacher as well as the student, who will be able to accomplish, at least, one section for every lesson. Instead of giving an appendix of miscellaneous questions at the end of the book, in imitation of several useful works on Arithmetic, I have adopted a different plan, which I conceive is attended with considerable advantage, and from which I have derived great assistance in my own experience. The plan to which I refer is this, the examples are arranged in sections, and each section contains a question from each rule, forming something like an examination paper for candidates either for new situations or promotion. The selection of the questions in each section has been made with a view to test the knowledge of Arithmetic, and the facility of performing, accurately, its operations; and I feel certain, from my experience in examinations and teaching, that any one who can work correctly one of these sections, in the space of three hours, need not be afraid of passing any arithmetical ordeal.

The advantage of such an arrangement to a teacher must be apparent, as he will readily know to which of the questions, in the section, his students are unable, by their unaided efforts, to give a solution; and thus to direct their attention to those parts of Arithmetic which such failures will never fail to indicate.

It is a question which experience has not hitherto determined, (at least not satisfactory to all engaged in the arduous and very important duty of teaching,) whether it is better to place the answers along with the questions, so that the pupil could have ready access to them, or to reserve the answers in a separate form for the use of the master only. Each method, I presume, has its advantages and its disadvantages; and the adoption in practice of either plan must necessarily depend very much on the class of pupils, as to age, general information, and the desire manifested by them steadily to acquire by perseverance a correct knowledge of the subject.

Without attempting to decide which of the two methods here adverted to is the best, I have thought it necessary to arrange the questions and their answers, so that either plan may be pursued. This is accomplished by printing the answers in a separate form, so that they may be supplied to, or withheld from, the students, according to the judgment and views of the teacher. In consequence of the simple rules of Arithmetic being now taught *vivâ vocé* to most children at an early age, it has been thought advisable to omit giving examples in Numeration, Addition, and Simple Subtraction; believing that such, if required, can be readily given by the intelligent teacher, and can therefore serve no other purpose beyond filling uselessly the pages of the book.

No teacher of experience has to learn the truth, that, the reasonings and explanations usually supplied in works on Arithmetic, are of very little use to the generality of youths; they are seldom or never read by them, simply because such explanations and reasonings are more easily conveyed orally by the teacher than by any written description, however graphic, clear, and intelligible it may be. This remark not only applies to Arithmetic, but also to "Euclid's Elements," and every other abstract science. It is in obedience, then, to this conviction, that I have supplied no more explanations and reasonings than those which I conceive the students will require for reference and committal to memory, after they have heard the explanation of the teacher, who should be always prepared with a critical knowledge of the subject to amplify, illustrate, and even anticipate the difficulties which surround the youthful mind.

Although the explanations have been purposely brief, yet I trust they will be found to contain the essential points, without which a knowledge of Arithmetic must be necessarily incomplete.

For the advantage of artizans and others who may use this collection of questions for the purpose of preparing themselves to pass an examination, I have given a solution, in full, to every question in one of the sections, together with such explanations as they appeared to demand, in order to make the operations intelligible and suggestive, to the solutions of similar questions in the remaining sections.

I hope this part of my plan will be useful to the aspiring artizans in directing, stimulating, and perfecting the knowledge of an important and pleasing subject, without which they cannot hope to rise to positions of trust and responsibility.

I know that there is great difficulty in carrying out any uniform plan of imparting knowledge, and developing the tender powers of youthful minds, which are as varied in their capabilities, modes of thought, power of retention, conception, and reflection, as are the heights and depths of the surface of the earth on which we tread. Still I cannot refrain from thinking, that in all the rules and illustrations intended for this purpose, there should be an evident anticipation of a future difficulty and a future progress. This I fear is too frequently lost sight of in the instruction of youth. For the sake of advancing too hastily the present progress of a young man, rules and explanations are not unfrequently enforced on his mind, that are not only of no use whatever in his more advanced studies, but they are a positive drag which weighs heavily on him in the prosecution of enquiries, either for self gratification or the improvement of social position. Such, I conceive, is the present defective mode of teaching what is commonly called the Double Rule of Three. I hope that teachers will not deem it presumption, if I state that the old plan of teaching the Single and Double Rule of Three by rule should be entirely abolished, and the methods of ratios and proportions, which more recent and correct views of this interesting subject have brought to light, should be made more prominent and intelligible.

Experience has convinced me that few, very few indeed, who have learnt the Rule of Three by rule, are able to work correctly a sum they have not previously seen, in the Double Rule of Three, in consequence of not being able to state it. Hence it is not an unusual thing for such to say "state the question for me, then I will work it." I may add, that those who are fortunate enough to be successful in stating the question have not that strong confidence in the correctness of the result which it is most necessary to attain in practical life.

Compound Multiplication and Division appear to me to afford beautiful exercises for teaching the important doctrine of ratios and proportions at an early period, and for laying a firm and durable substratum on which to raise a higher and nobler edifice, by habits of close reasoning, than any that could be hoped for by teaching rules and statements, which only perplex, without enlightening the understanding. Because I have deemed it necessary to exclude, in a great measure, the reasonings and explanations usually employed in Arithmetics, it must not be inferred that I disapprove of them; nothing can be more opposite to my views. Arithmetic should be taught and learnt rationally, as far as possible ; but the capabilities of youth, at an early age, are so varied, that no uniform plan, which the ingenuity of man can possibly devise in a written form, will suit every capacity, or be uniformly successful. Hence, while examples to illustrate the reasoning and stimulate practice are alike useful to all, the explanations must necessarily be varied by the teacher to suit individual cases.

However valuable the mental discipline of rational Arithmetic may be in awakening the dormant powers of the understanding, still there are those who attach greater importance, and, perhaps, justly in some cases, to a facility in arithmetical computation which is developed in the actual concerns of practical life, than to all the refined reasoning processes which mathematicians can invent. I shall not attempt to combat this opinion, but receive it as a truth, which has been, no doubt, induced by the difficulties that have been found to surround the daily avocations of practical men.

In the execution of my design I cannot hope that it is entirely free from defects; I have done my best, however, to guard against them, and I trust that errors in the answers to the questions will be few and unimportant in comparison with the great number of examples. As the advantages of education become better appreciated, and the means of extending it to the cottages of the people more general and liberal than they are at present, the knowledge of the various branches of Arithmetic, Algebra, and Geometry, will become attainable by the great majority of the working classes.

An obvious consequence of this enlightening and ennobling scheme, is, that many of the sons of workmen will have induced, by a liberal education in youth, the seeds of a power which can only fructify, bloom, and ripen into fruit by means of a higher and more extended study in the fields of pure and mixed science. To such individuals Mechanics' Institutions, Athenæums, and Public Libraries, must be of incalculable advantage. And as the study of such individuals must necessarily be conducted by very limited resources indeed, without the aid and advice which teachers can readily supply, a few remarks with respect to the subjects of study, and books to be obtained, will not be entirely void of interest and usefulness.

If a correct appreciation of Algebraical symbols and reasoning is desirable, Euler's "Algebra" should be carefully read; the explanatious being luminous and from the hand of a great master, cannot fail to interest, instruct, and clear the subject from the thick mist in which some less cultivated authors have enveloped it. If facility of using algebraical formulæ and artifices for solving equations and problems is requisite, "Wood's Algebra," by Lund, will be found useful. There are several good books on the various branches of Algebra, such as, Hind's, Hall's, Simpson's, Murphy's "Equations," Young's, Hymer's "Equations," Steven's "Algebraical Equations." Any of these works may be consulted with advantage.

The Elements of Euclid, with their application, including the first four books, the definitions of the fifth book with their algebraical exposition, the sixth book and as far as the nineteenth problem of the eleventh book should be familiar to every student who aspires to a complete knowledge of the mathematical sciences.

The elements of Euclid, although written nearly 300 years before the Christian era under the princely patronage of Ptolemy Lagus, King of Egypt, is still, notwithstanding several obvious defects which may or may not admit of correction, the purest and most complete system of deductive reasoning which civilisation, science, and genius, during a period of two thousand years have been able to produce. Its geometrical exactness and comprehensiveness, the fact of its having been a text book for every civilised nation in the world, and that people possessing every shade of difference of opinion respecting political and theological subjects have entertained exactly the same views on this book, its great antiquity, the venerable characters of every age and nation who have expressed their admiration of its arrangement and contents, combine in one phalanx to raise the elements of

Euclid on a pedestal to which no other similar production can possibly aspire.

The material utilitising spirit which has been developed by successful manufacturers, merchants, and engineers of the present century, has induced many unsuccessful attempts to shorten the path to science, and make its devious ways more straight and easy of access. Such attempts, of course have been, and no doubt will be in future, abortive ; that there can be no royal road to geometry is just as true now as it was at the time of its memorable utterance.

It is one of the mistaken ideas of the present age, that the acquisition of knowledge can be made easy, that mathematicians and philosophers can be readily brought forth, without that excessive labour and patience, the history of which is conspicuous in the lives and productions of every distinguished man.

The works on geometry which may be studied after Euclid with benefit, are Simpson's and Emerson's "Geometry," Leslie's "Geometrical Analysis," the "Lady's Diary," one of the most useful annual periodicals that any nation or age can boast of.

If the cultivation of practical astronomy, mathematical geography, and the higher branches of science be desirable, then trigonometry, both plane and spherical, should be well studied. This subject, in its present form, is due to the investigations and researches of the moderns ; amongst the most distinguished of its cultivators stand Thomas Simpson, Euler, and De Moivre.

With trigonometry, in fact, astronomy first received such a degree of exactness as justly to merit the name of science ; and every improvement that has been made in trigonometry to the present time, has been attended with corresponding improvements in all parts of physical science. (See Article, "Trigonometry," in the "Encyclopædia Metropolitana." By G. B. Airy.) There are several good books on this subject such as Emerson's, Simpson's, Hann's, Snowball's, Hind's, Keith's, Lardner's, Young's, whose works are characterised by clearness of style and accuracy of matter.

Such a knowledge of algebra, geometry, and trigonometry as that which has been shadowed forth, in the foregoing paragraphs, will enable any one to read with advantage elementary books on physical science, such as mechanics, including statics, and dynamics, hydrostatics, hydraulics, optics, pneumatics, practical astronomy, navigation, electricity, and galvanism; but if the higher applications of mathematics to physical astronomy, and the higher dynamics are required, then the study of analytical geometry, the differential and integral calculus, is absolutely necessary. An elementary work on mechanics, including the dynamics of constant forces, may be read with benefit during the time of studying Euclid, algebra and trigonometry. It is humiliating to confess that works on mechanics of the class here alluded to, are by no means numerous; and many of those we do possess have been written in a manner too restrictive for general purposes. The best we are acquainted with in the English language, are Emerson's, Snowball's, Hann's, Tate's, Potter's, Whewell's, and Moseley's "Mechanics."

Analytical geometry may be studied in conjunction with the differential and integral calculus.

The subject of analytical geometry is entirely due to the moderns; in fact, it was suggested to the mind of Descartes in 1637, when he successfully attacked a geometrical problem of the ancients which could not be solved either by Euclid or Apollonius. It is an indispensable instrument in the investigation of the properties of straight lines in and about curves; and, indeed, but little progress could be made in the higher branches of mathematics without a thorough command of this subject. It was the first great step that was taken by the modern mathematicians, beyond the boundary to which the ancients had successfully laboured. And it is humiliating to know, that the prejudices of the scientific men of this country were such as to prevent the introduction of this improved system of geometry until a comparatively recent period. Until, in fact, it was made obvious that the profound researches of the Bernoullis, Euler, and other eminent foreigners could scarcely be read, certainly not fully appreciated by the best mathematicians of this country. The works on this subject are, Hamilton's "Principles of Analytical Geometry," Hymer's "Treatise on Analytical Geometry," of three dimensions; Lardner's "System of Algebraical Geometry"; Young's "Elements of Analytical Geometry," a good book for students without the assistance of a tutor; O'Brien's "Coordinate Geometry," is a good text-book; Gregory's "Analytical Geometry," of three dimensions, is a most elaborate and profound work.

Those who are ambitious to become acquainted with the recent researches of the Germans, and the French, in the abbreviated system of geometry first adopted by Plücker, must read attentively "Salmon's Conic Sections," and his higher plane curves. These works are certainly the best of the kind published in the English language.

The differential calculus, which can be read with analytical geometry, gives great power to the method of Descartes, which could not be made available to the determination of the various questions of areas and lengths of curves, volumes, and surfaces of solids, without the powerful aid of the integral calculus. This branch of pure mathematics is due to the genius of Newton, who published it under the title of "Fluxions;" and also to Leibnitz, who may be considered to have discovered the same method under the title of the "Differential Calculus."

The fluxions and fluents of Newton, which occupied the attention of mathematicians during a century in England for reasons which need not be repeated here, are exactly the same, except in notation, as the differential and integral calculus of Leibnitz, which were extensively cultivated in the hands of Bernoulli, Euler, D'Alembert, Lagrange, and La Place.

The distinguishing algorithm of fluxions was a dot (·), while that of the differential calculus was a (*d*); the latter notation is considered by all preferable to the former, and consequently there have been no works published on fluxions since the memorable change, at the commencement of the present century, in the University of Cambridge.

Amongst the best works on the calculus must be mentioned Hind's, Hall's, Young's, De Morgan's; the most extensive in the language, and the cheapest, but very difficult to read.

The "Principia" of Newton will ever be regarded with thrilling interest by cultivators of mathematical physics, as containing the first successful effort to explain, by mathematical laws, the complex astronomical phenomena. But such a work could not be now recommended for the study of physical astronomy: the best for this purpose are "Pratt's Mechanical Philosophy," "Earnshaw's Dynamics," "Whewell's Dynamics," "Airy's Mathematical Tracts," "Young's Mechanics," "Todhunter's Analytical Statics."

If a popular and simple exposition of philosophy and astronomy is required, then the "Hand-book of Natural Philosophy and Astronomy," by Dr. Lardner, may be read with advantage.

ROBERT RAWSON.

PORTSMOUTH, *October* 30, 1854.

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ARITHMETIC.

Page.	Sec.	Ex.	For	Read
78	32	(98)	Then, $\frac{178}{7} \div$	Then, $\frac{178}{7} +$
89	2	(4)	at 2*s.* 10*d.*	2*l.* 10*s.*
90	7	(55)	(55)	(25)

PART THE FIRST.

ARITHMETICAL TABLES.

MULTIPLICATION TABLE.

1	2	3	4	5	6	7	8	9	10	11	12
2	4	6	8	10	12	14	16	18	20	22	24
3	6	9	12	15	18	21	24	27	30	33	36
4	8	12	16	20	24	28	32	36	40	44	48
5	10	15	20	25	30	35	40	45	50	55	60
6	12	18	24	30	36	42	48	54	60	66	72
7	14	21	28	35	42	49	56	63	70	77	84
8	16	24	32	40	48	56	64	72	80	88	96
9	18	27	36	45	54	63	72	81	90	99	108
10	20	30	40	50	60	70	80	90	100	110	120
11	22	33	44	55	66	77	88	99	110	121	132
12	24	36	48	60	72	84	96	108	120	132	144

TROY WEIGHT.

24 grains .... = 1 pennyweight.
20 pennyweights = 1 ounce
12 ounces .... = 1 pound.
7,000 grains .... = 1 pound avoirdupois.
5,760 grains .... = 1 pound troy.
3⅕ grains .... = 1 carat of diamonds.
240 grains .... = 1 carat of gold or silver.

By this weight gold, silver, and jewellery are weighed, and philosophical experiments estimated.

AVOIRDUPOIS WEIGHT.

16 drams . . . . . . = 1 ounce.
16 ounces . . . . . . = 1 pound.
14 pounds . . . . = 1 stone.
28 pounds . . . . . . = 1 quarter.
4 quarters . . . . = 1 hundred weight.
112 pounds . . . . = 1 hundred weight.
20 hundred weight . = 1 ton.

By this weight the common necessaries of life are measured.

56 pounds . . . . . . = 1 firkin of butter.
24 ounces . . . . . . = 1 great pound of silk.
240 pounds . . . . = 1 pack of wool.

APOTHECARIES' WEIGHT.

20 grains . . . . = 1 scruple.
3 scruples . . . . . = 1 dram.
8 drams . . . . = 1 ounce.
12 ounces . . . . = 1 pound.

Medical prescriptions are prepared by this weight.

LONG MEASURE.

4 inches . . . . . . = 1 hand.
12 inches . . . . . . = 1 foot.
3 feet . . . . = 1 yard.
6 feet . . . . = 1 fathom.
5½ yards . . . . . = 1 rod or pole.
40 rods or poles . . . = 1 furlong = 220 yards.
8 furlongs . . . . = 1 mile.
3 miles . . . . . = 1 league.
6080 feet . . . . . = 1 knot or nautical mile.
1,760 yards = 5280 feet . = 1 mile
$\frac{1}{12}$ inch . . . . = 1 line.
⅓ inch . . . . = 1 barley corn.
9 inches . . . . . = 1 span.
18 inches . . . . . = 1 cubit.
5 feet . . . . . = 1 space.
69⅙ miles . . = 1 degree.

SQUARE MEASURE.

144 square inches . . = 1 square foot.
9 square feet . . = 1 square yard.
30¼ square yards . . = 1 square rod, pole, or perch.
40 perches . . . . = 1 rood.
4 roods . . . . . = 1 acre = 4,840 square yards.
640 square acres . . = 1 square mile.
22 yards = 100 links = 1 Gunter's chain.
10 chains long by 1 chain wide } = 1 acre.
30 acres . . . . . = 1 yard of land.
100 acres . . . . . . = 1 hide of land.

SOLID MEASURE.

1,728 cubic inches . . = 1 cubic foot.
27 cubic feet . . = 1 cubic yard.

CLOTH MEASURE.

2¼ inches . . . . . = 1 nail.
4 nails . . . . . . = 1 quarter.
4 quarters . . . . . = 1 yard.
5 quarters . . . . . = 1 ell.
3 quarters . . . . . = 1 Flemish ell.
6 quarters . . . . . = 1 French ell.

CAPACITY.

4 gills or noggins . = 1 pint.
2 pints . . . . . . = 1 quart.
2 quarts . . . . . = 1 pottle.
4 quarts . . . . . = 1 gallon.
2 gallons . . . . . = 1 peck.
4 pecks . . . . . . = 1 bushel.
8 bushels . . . . . = 1 quarter.
5 quarters . . . . . = 1 load.

COAL MEASURE.

3 bushels . . . . . = 1 sack.
12 sacks . . . . . . = 1 chaldron.

BEER MEASURE.

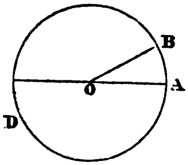
9 gallons . . . . . = 1 firkin.
18 gallons . . . . . = 1 kilderkin.
36 gallons . . . . . = 1 barrel.
54 gallons . . . . . = 1 hogshead.
108 gallons . . . . . = 1 butt.
2 butts . . . . . . = 1 ton.

WINE MEASURE.

10 gallons . . . . . = 1 anker.
18 gallons . . . . . = 1 runlet.
42 gallons . . . . . = 1 tierce.
63 gallons . . . . . = 1 hogshead.
84 gallons . . . . . = 1 puncheon.
126 gallons . . . . . = 1 pipe.

ANGULAR MEASURE.

60 seconds . . . = 1 minute.
60 minutes . . . = 1 degree.
15 degrees . . . = ½ sign of the zodiac.
30 degrees . . . = 1 sign of the zodiac.
90 degrees . . . = 1 quadrant, or ¼ part of a circle.
180 degrees . . . = 1 semi-circumference.
360 degrees . . . = 1 circumference of a circle, or 12 signs of the zodiac.



If the circumference of a circle, A B D, be divided into 360 equal parts, then A B, one of these parts, is called a degree.

The zodiac is a belt in the heavens which extends 8 degrees on each side of the ecliptic.

NUMBER MEASURE.

12 units . . . . = 1 dozen.
12 dozen . . . . = 1 gross.
12 gross . . . . = 1 great gross.
20 units . . . . = 1 score.
24 sheets . . . . = 1 quire of paper.
20 quires . . . . = 1 ream.
2 reams . . . . = 1 bundle.
12 skins of parchment . . = 1 roll.

PENCE TABLE.

4 farthings . . . . = 1 penny.
12 pennies . . . . = 1 shillings.
20 shillings . . . . = 1 pound or sovereign.
5 shillings . . . . = 1 crown.
21 shillings . . . . = 1 guinea.

		s.	d.			s.	d.
12	pence . . =	1	0	60	„ . . . . . =	5	0
20	„ . . . . . =	1	8	70	„ . . . . . =	5	10
24	„ . . . . . =	2	0	72	„ . . . . . =	6	0
30	„ . . . . . =	2	6	80	„ . . . . . =	6	8
36	„ . . . =	3	0	84	„ . . . . . =	7	0
40	„ . . . . . =	3	4	90	„ . . . . . =	7	6
48	„ . . . . . =	4	0	96	„ . . . . . =	8	0
50	„ . . . =	4	2	100	„ . . . . . =	8	4

OLD ENGLISH COINS.

s.	d.		s.	d.	
13	4	. . . = 1 mark.	27	0	. . . = 1 moidore.
6	8	. . . = 1 noble.	10	0	. . . = 1 angel.
0	6	. . . = 1 tester.	23	0	. . . = 1 Carolus.
0	4	. . . = 1 groat.	25	0	. . . = 1 Jacobus.

TABLES OF ALIQUOT PARTS.

d.	s.	d.	s.	s. d.	£.	s. d.	£.
1½	= $\frac{1}{8}$ of 1	7½	= $\frac{5}{8}$ of 1	2 6	= $\frac{1}{8}$ of 1	10 0	= $\frac{1}{2}$ of 1
3	= $\frac{1}{4}$ „	8	= $\frac{2}{3}$ „	4 0	= $\frac{1}{5}$ „	12 6	= $\frac{5}{8}$ „
4	= $\frac{1}{3}$ „	9	= $\frac{3}{4}$ „	5 0	= $\frac{1}{4}$ „	13 4	= $\frac{2}{3}$ „
4½	= $\frac{3}{8}$ „	10½	= $\frac{7}{8}$ „	6 8	= $\frac{1}{3}$ „	15 0	= $\frac{3}{4}$ „
6	= $\frac{1}{2}$ „			7 6	= $\frac{3}{8}$ „	17 6	= $\frac{7}{8}$ „

TIME.

60 seconds	. = 1 minute.	7 days .	. = 1 week.
60 minutes	. = 1 hour.	4 weeks	. = 1 lunar month.
24 hours	. . = 1 day.	365 days .	. = 1 year.

A *solar* year is the time which the *earth* takes to perform a revolution in its orbit (called the ecliptic) round the sun; and has been determined, from a great number of observations, made by the greatest astronomers in Europe, to be 365 days, 5 hours, 48 minutes, 47½ seconds. A solar day is the interval between the successive returns of the centre of the sun's disk to the meridian, and is divided into 24 equal parts, called hours.

For Remembering the Days in each Month.

Thirty days hath September, April, June, and November;
February hath twenty-eight alone; and all the rest have thirty-one;
Except leap year, and that is the time
When February's days are twenty-nine.

STANDARDS OF MEASURE.

Abstract Numbers are the numbers 1, 2, 3, &c., used without any reference to the things numbered. When abstract numbers are employed to express the things which are numbered, as 5 apples, 12 plums, &c., they are called *concrete numbers.*

The standard gold of England is 22 parts out of 24 pure gold, and the remaining 2 parts are alloy of silver and copper. From a pound troy 46$\frac{29}{40}$ sovereigns, = £46 14s. 6d., are coined.

The standard silver of England is 37 parts out of 40 pure silver, and the remaining 3 parts an alloy (copper). From a pound troy 66 shillings are coined.

Twenty-four pence are coined from a pound, avoirdupois, of copper.

A legal tender in copper does not exceed 12 pence, and in silver does not exceed 40 shillings, gold being the standard of the country.

In an Act of Parliament, passed in 1824, and which came into full force in January 1826, entitled "An Act of Imperial Weights and Measures," it was fixed as follows :—

That the length of a simple pendulum, oscillating in a second in vacuo, in the latitude of London, and at the level of the sea, be 39.13929 inches, 36 of which make a yard.

A cubic inch of distilled water, at the temperature of 62 degrees Fahrenheit, and when the barometer stands at 30 inches, weighs 252.458 grains ; 5,760 of which grains make a pound troy, and 7,000 of which make a pound avoirdupois.

The imperial *gallon* contains 277.274 cubic inches, which is equal in space to that occupied by 10 pounds avoirdupois of distilled water, weighed in air, at a temperature of 62°, when the barometer stands at 30 inches.

MULTIPLICATION.

Section 1.

(1) 356789×2
(2) 500678×6
(3) 3478904×8
(4) 5067894×9
(5) 78473×7
(6) 456785×5

Section 2.

(7) 384678904×11
(8) 45678904×12
(9) 5678409×11
(10) 3467809×9
(11) 5674567×12
(12) 33456785×8

Section 3.

(13) 5567945×5
(14) 7346758×4
(15) 6567904×3
(16) 5406785×2
(17) 7856345×9
(18) 3456789×11

Section 4.

(19) 437506×22
(20) 5976784×34
(21) 67356789×13
(22) 34678593×14
(23) 56789456×34
(24) 83784567×54

Section 5.

(25) 345678×59
(26) 304678×63
(27) 5060785004×59
(28) 34046785×78
(29) 56789104×99
(30) 3406705×80

Section 6.

(31) 304567850×57
(32) 730458904×77
(33) 3567894×34
(34) 67894567×54
(35) 4395678×86
(36) 5678459×96

Section 7.

(37) 8967854×54
(38) 37807056×17
(39) 8067850×13
(40) 56789304×15
(41) 37689405×19
(42) 78543457×29

Section 8.

(43) 56785404×122
(44) 34675×152
(45) 47689×345
(46) 906789×406
(47) 3046789×506
(48) 40567891×356

Section 9.

(49) 3567890×346
(50) 5678945×567
(51) 348967×506
(52) 594678×898
(53) 53450678×346
(54) 4060705×307

Section 10.

(55) 8456784×309
(56) 4560784×809
(57) 56785430×990
(58) 3467805×840
(59) 98078654×9807

DIVISION.

Section 1.

(1) 283925÷5　(2) 203562÷3　(3) 470736÷6
(4) 590660÷7　(5) 2764856÷8　(6) 3876075÷9

Section 2.

(7) 10380458÷11　(8) 2440410÷6　(9) 1219140÷4
(10) 7242102÷9　(11) 2131969÷7　(12) 2271400÷4

Section 3.

(13) 1016146848÷12　(14) 38138034÷11　(15) 6805140÷12
(16) 1387112÷4　(17) 44545335÷5　(18) 9122034÷3

Section 4.

(19) 497568995÷55　(20) 13405788÷44　(21) 25749696÷32
(22) 26352768÷52　(23) 2041289÷67　(24) 2977686÷37

Section 5.

(25) 2271752÷56　(26) 4063335÷87　(27) 2985766÷98
(28) 4934864÷88　(29) 27953104÷76　(30) 5574195÷99

Section 6.

(31) 4781452÷13　(32) 7017060÷15　(33) 7949256÷14
(34) 9669725÷25　(35) 2041289÷67　(36) 67593876÷84

Section 7.

(37) 13268700÷345　(38) 634392÷132　(39) 863056÷152
(40) 4573989÷567　(41) 19712149÷647　(42) 4565112÷804

Section 8.

(43) 15762203÷509　(44) 37812301÷809　(45) 20859363÷567
(46) 35633928÷876　(47) 17294720÷305　(48) 2085426÷567

Section 9.

(49) 70489092÷876　(50) 16286072÷3416
(51) 52828112÷9304
(52) 385019502÷5678　(53) 32250700256÷56789
(54) 663894474÷8934

Section 10.

(55) 237793261368÷678504 (56) 466008370968÷80367

(57) 2021919569376÷583046

Section 11.

(58) 257107827480÷50806 (59) 700988723520÷123456

(60) 2845820017095÷314567

Section 12.

(61) 23181004089÷30567 (62) 17300835552÷56784

(63) 66799389272÷80437

Section 13.

(64) 6986826400÷12304 (65) 4910068398924÷586781

(66) 928288360230÷304678

Section 14.

(67) 252388104696÷83004 (68) 48201125278÷58034

(69) 474539752300÷56785

Section 15.

(70) 1962852528÷34567 (71) 50648999115÷59345

(72) 2530187130768÷830467

Section 16.

(73) 1757454362250÷346785 (74) 14232223595÷13467

(75) 208273477250÷58375

Section 17.

(76) 17077430040÷20460 (77) 244260095460÷346785

(78) 75700322621÷83677

Section 18.

(79) 14673616726302÷321234 (80) 13760431789390+356785

(81) 3224812508646222÷5678543

Section 19.

(82) 25508010133780+304846 (83) 170858983241540+304678

Section 20.

(84) 255454844684428+834607 (85) 78967354869+98765

REDUCTION.

Section 1.

Reduce

(1) 632*l.* to farthings.

(2) 356 guineas to farthings.

(3) 456*l.* 10*s.* to farthings.

(4) 56,789 farthings to pounds.

(5) 396,789 halfpence to guineas.

(6) 4,379,567 pence to pounds.

Section 2.

(7) 55*l.* 6*s.* 10*d.* to farthings.

(8) 1,045*l.* 16*s.* 7¾*d.* to farthings.

(9) 435*l.* 19*s.* 9¼*d.* to farthings.

(10) 846 halfpence to crowns.

(11) 346,785 pence to guineas.

(12) 43,765 farthings to pounds.

Section 3.

(13) 346*l.* 15*s.* 6½*d.* to farthings.

(14) 8,467*l.* 10*s.* 8½*d.* to farthings.

(15) 34,567*l.* 3*s.* 6*d.* to pence.

(16) 346 crowns to farthings.

(17) 467 halfcrowns to farthings

(18) 56,785 farthings to guineas.

Section 4.

(19) 8,494 pence to 10*s.* pieces.

(20) 3,467 farthings to pounds.

(21) 3,867 pence to guineas.

(22) 5,678*l.* 15*s.* 7½*d.* to farthings.

(23) 346*l.* 19*s.* 9¾*d.* to farthings.

(24) 5,678*l.* 18*s.* 7¾*d.* to farthings.

Section 5.

(25) 2 tons to ounces.

(26) 3 tons to ounces.

(27) 56 tons to ounces.

(28) 35,678 lbs. to tons.

(29) 586,784 lbs. to tons.

(30) 367,504,376 lbs. to tons.

Section 6.

(31) 56½ tons to pounds.

(32) 34 tons to pounds.

t. cwt. qrs. lbs.
(33) 54 8 3 26 to ounces.

(34) 456 tons to ounces.

(35) 46,785 lbs. to tons.

(36) 567,850 lbs. to tons.

Section 7.

(37) 4 miles to inches.

m. f. p. yds. ft.
(38) 1 7 28 2 1 to inches.

(39) 56,785 feet to miles.

(40) 314,067 inches to miles.

(41) 57,607 yards to miles.

f. yds. ft. in.
(42) 5 3 2 7 to inches.

Section 8.

Reduce

(43) 13 lbs. to grains.

(44) 15lbs. 17 dwts. to grains.

(45) 1,567,854 grains to pounds.

(46) 718,560 grains to pounds.

lbs. dwts. gr.
(47) 115 10 5 to grains.

(48) 813,567 grains to pounds.

Section 9.

(49) 42 square yds. to sq. ins.

(50) 52 square yds. to sq. ins.

(51) 5,678 sq. ins. to sq. yds.

(52) 34,678 sq. ins. to sq. yds.

sq. yds. sq ins.
(53) 80 126 to sq. ins.

(54) 356,780 sq. ins. to sq. yds.

Section 10.

(55) 84 acres to roods.

(56) 56 acres to roods.

(57) 31,467 poles to acres.

(58) 3 acres to square inches.

a. r. p. yds. ft. ins.
(59) 1 2 5 27 4 130 to ins.

(60) 56,785 sq. yds. to acres.

Section 11.

(61) 2 loads to quarts.

(62) 3 loads to gills.

(63) 31,467 gallons to loads.

(64) 567,854 pints to loads.

ld. qu. b. p. gall. qu.
(65) 1 3 5 3 1 2 to pints.

(66) 5,679,430 pints to loads.

Section 12.

(67) 5 days to seconds.

d. h. m. s.
(68) 12 3 40 30 to seconds.

(69) 346,789 seconds to days.

(70) 546,785 hours to years.

(71) 13,567 inches to furlongs.

y. m. w.
(72) 4 5 2 to hours.

Section 13.

(73) 31,467 grains to lbs. troy.

(74) 3,467,856 seconds to months.

(75) 23,467 ounces to tons.

(76) 83,467 yards to acres.

m. w. d.
(77) 3 2 4 to hours.

(78) 567,805 seconds to days.

Section 14.

(79) 34*l.* 14*s.* 6*d.* to pence.

(80) 3,456 crowns to farthings.

(81) 83*l.* 4*s.* 7½*d.* to farthings.

(82) 367,853 crowns to 4*d.* pieces.

(83) 3,467,853 farthings to £.

(84) 385 crowns to £.

Section 15.

Reduce

t. cwt. qr. lb. oz.
(85) 3 2 3 21 3 to ozs.

Reduce

(86) 345,678 ounces to tons.

(87) 567,854 pounds to tons.

tons. cwt. qr.
(88) 2 3 2 to pounds.

lbs. dwts.
(89) 3 14 to grains.

(90) 315,678 grains to lbs. troy.

Section 16.

(91) 567,854 pints to loads.

(92) 356,785 gills to quarters.

l. q. b. p. g. q.
(93) 3 2 5 2 1 3 to pints.

q. b. p.
(94) 6 4 3 to gills.

(95) 567,850 hours to years.

y. m. w. d.
(96) 3 3 4 5 to hours.

Section 17.

t. cwt. qrs.
(97) 2 3 2 to pounds.

lbs. dwts.
(98) 3 14 to grains.

(99) 345,678 farth. to guineas.

(100) 315,678 grains to lbs. troy and avoirdupois.

lbs. dr. sc.
(101) 2 5 2 to grains.

Section 18.

(102) 20 miles to feet.

(103) 31,416,785 feet to miles.

(104) 341,678 perches to acres.

a. p.
(105) 2 30 to square yards.

(106) 35 perches to sq. inches.

(107) 56,785 cubic ins. to cub. yds.

Section 19.

c. y. ft. ins.
(108) 34 18 132 to cubic ins.

w. d. h.
(109) 4 3 5 to minutes.

(110) 634,567 mins. to months.

(111) Find the mins. from 12 o'cl. on Sunday to 3 o'cl. Friday.

(112) 14*l.* 16*s.* 7¾*d.* to farthings.

Reduce
(113) 314,678 crowns to 10*s.* pieces.

Section 20.

t. cwt. qr. lb.
(114) 5 3 2 14 to ounces.

(115) 31,467 ounces to tons.

(116) 314,167 lbs. troy to grns.

lbs. dwt. gr.
(117) 5 15 14 to grains.

(118) 12 pounds to scruples.

(119) 123 fur. to feet.

Section 21.

Reduce. Reduce.

(120) 31,416 perches to acres. (121) 56,784 minutes to months.

a. r. p.

(122) 3 3 39 to square yds. (123) 27*l.* 10*s.* 8*d.* to 4*d.*-pieces.

(124) 6,700,986 ounces to tons. (125) 17 lbs. avoir. to ounces troy.

Section 22.

(126) 346*l.* 5*s.* 8*d.* to 4*d.*-pieees. (127) 56*l.* 3*s.* 9*d.* to 3*d.*-pieces.

t. cwt. lb.

(128) 3 4 5 to half-ounces. (129) In 345*l.* 15*s.* how many half-crowns?

(130) Reduce 345 ninepenny-pieces to eightpenny-pieces.

(131) In what time can half a million of money be counted, in sovereigns, at the rate of 100 per minute?

To reduce miles per hour to feet per second.

Reduce 20 miles per hour to feet per second.

20 = miles per hour.

20 × 3 × 1,760 = feet per hour.

$$\frac{20 \times 3 \times 1{,}760}{60 \times 60} = \text{feet per second.}$$

$$= \tfrac{88}{3} = 29\tfrac{1}{3}.$$

Section 23.

(132) Reduce 30 miles per hour to feet per second.
(133) „ 45 „ „
(134) „ 48 „ „
(135) „ 25½ „ „
(136) „ 35½ „ „
(137) „ 46½ „ „

Section 24.

(138) „ 16 feet per second to miles per hour.
(139) „ 24 „ „
(140) „ 26 „ „
(141) „ 20¼ „ „
(142) „ 34½ „ „
(143) „ 32 „ „

Section 25.

(144) Reduce 24¾ miles per hour to feet per minute.
(145) „ 60 „ „
(146) „ 65¼ „ „
(147) „ 37¼ „ „
(148) „ 46½ „ „
(149) „ 52½ „ „

Section 26.

(150) „ 55 feet per second to miles per hour.
(151) „ 34½ „ „
(152) „ 44¼ „ „
ft. in.
(153) „ 52 10 „ „
(154) „ 32 2 „ „
(155) „ 26 3 „ „

If a body be moving at the rate of 26 *feet* 3 *inches* = 26¼ *feet per second, then* 26¼ *is called the velocity of the body; or, the velocity of a body is the number of feet which it moves over per second at a uniform rate.*

Section 27.

(156) A body moves at the rate of 23 miles per hour, find its velocity.
(157) „ 18 „
(158) „ 16 „
(159) „ 34⅓ „
(160) „ 52⅛ „
(161) „ 32¾ „
(162) „ 55¼ „
(163) „ 60 „
(164) „ 9¾ „
(165) „ 8¾ „

ADDITION.

Section 1.

(+)

	£.	s.	d.		£.	s.	d.		£.	s.	d.		£.	s.	d.
(1)	32	14	6	(2)	136	10	9½	(3)	124	1	0½	(4)	1146	18	10½
	52	10	3		156	12	3¼		156	2	3¼		1467	19	1¾
	83	4	2		836	14	3¼		57	3	4¾		346	15	3½
	65	8	3		32	10	4¾		184	12	8¾		46	10	1½
	122	19	10		15	6	2¼		65	13	7½		84	5	5½

Section 2.

(5)	1367	15	6¼	(6)	1467	18	7½	(7)	3146	11	11¼	(8)	1046	17	8½
	346	19	1½		8347	19	3¾		2167	12	10¾		567	18	3½
	84	13	4¼		1360	15	4½		5867	13	10½		834	15	2½
	56	15	8½		8360	13	5½		4675	15	3½		467	13	5¼
	146	18	1½		3460	18	4½		834	17	7½		803	14	4½
	85	15	6½		804	5	2¾		430	9	5¾		304	16	7¼

Section 3.

(9)	1467	15	7½	(10)	1367	14	8½	(11)	5806	14	3½	(12)	5675	13	4½
	324	14	1½		8367	10	5½		8307	15	6½		836	15	2½
	834	19	3¼		3567	13	2½		407	16	3½		403	15	3¼
	567	19	3½		836	14	2¾		47	15	6½		59	6	6½
	68	4	4		46	15	3¾		484	10	2½		73	7	4½
	32	3	3½		185	19	9½		67	0	0		99	19	9½
	102	15	5¾		506	3	3½		84	5	5½		999	2	6½
	59	16	6½		84	14	5½		32	1	6		567	2	3½

Section 4.

(13)	8467	15	7½	(14)	1046	16	7½	(15)	3467	15	7½	(16)	1306	18	8¼
	476	13	2½		406	0	7¾		567	13	4½		5678	19	9¾
	84	15	9½		506	15	3½		84	15	3½		11	11	11¾
	5	6	1¼		804	17	7½		32	12	2½		8	8	8¾
	55	3	3¼		506	18	9½		153	16	7½		135	6	6½
	76	18	8½		304	15	7½		55	19	9½		56	16	8¾
	104	7	9½		85	5	5½		174	15	5½		146	15	5¼

Section 5.

	tons.	cwt.	qrs.	lbs.		tons.	cwt.	qrs.	lbs.
(17)	122	15	2	23	(18)	156	18	1	26
	12	13	1	27		1346	15	2	17
	14	15	3	16		304	10	1	18
	10	5	2	15		46	9	0	5
	15	16	1	14		8	1	1	1
	83	14	3	5		9	2	3	4

Section 5 (*continued*).

	qrs.	lbs.	oz.	dr.
(19)	56	9	5	6
	132	14	12	11
	42	10	11	13
	52	4	6	7
	81	7	8	3
	8	4	3	2

	qrs.	lbs.	oz.	dr.
(20)	567	26	13	14
	83	24	15	11
	142	11	14	9
	94	6	13	10
	52	5	13	14
	8	9	7	6

Section 6.

	tons.	cwt.	qrs.	lbs.
(21)	132	15	1	14
	85	6	0	26
	4	3	2	10
	132	5	3	12
	84	7	1	27
	52	8	2	19
	19	8	1	20
	52	19	1	24

	tons.	cwt.	qrs.	lbs.
(22)	132	15	1	13
	84	17	0	17
	48	13	1	11
	54	2	2	12
	175	19	3	9
	354	18	1	14
	85	17	2	13
	94	15	1	15

	qrs.	lbs.	oz.	dr.
(23)	4	26	14	13
	5	19	9	9
	94	15	15	14
	56	13	14	13
	94	5	5	8
	87	17	7	9
	79	19	9	9
	89	18	8	7

	qrs.	lbs.	oz.	dr.
(24)	883	5	15	11
	987	17	15	10
	876	16	9	8
	968	27	8	9
	879	25	8	11
	543	5	12	9
	987	17	13	14
	87	19	9	8

Section 7.

	lbs.	oz.	dwt.	grs.
(25)	132	11	19	23
	94	10	18	22
	56	9	17	21
	89	11	10	14
	56	5	18	23
	98	4	13	22
	52	8	15	16

	lbs.	oz.	dwt.	grs.
(26)	848	10	14	20
	56	7	18	21
	84	10	11	12
	56	8	9	8
	89	4	18	19
	92	5	17	15
	82	5	18	19

	oz.	dr.	sc.	grs.
(27)	15	7	2	19
	84	6	1	15
	92	5	2	18
	54	6	1	15
	82	7	2	16
	19	0	0	18
	84	3	2	8

	lbs.	oz.	dr.	sc.
(28)	98	11	7	2
	89	10	6	1
	52	8	5	0
	83	5	6	1
	98	3	5	1
	54	5	6	0
	89	6	7	2

Section 8.

	poles.	yds.	ft.	ins.
(29)	132	5	2	11
	56	2	1	9
	84	3	2	10
	56	5	1	9
	84	0	0	8
	94	5	2	9
	56	3	2	11

	poles.	yds.	ft.	ins.
(30)	845	4	1	8
	56	1	2	9
	83	2	1	7
	85	0	2	11
	56	5	2	5
	87	4	1	10
	94	3	2	9

	acres.	rds.	p.	sq. yds.
(31)	456	3	28	29
	45	2	38	26
	83	1	14	19
	56	3	24	14
	83	2	26	27
	57	1	8	9
	75	3	18	29

	acres.	rds.	p.	sq. yds.
(32)	32	3	27	17
	46	2	37	3
	84	1	38	4
	45	3	27	14
	97	1	5	15
	87	2	24	3
	92	1	35	15

Section 9.

	l.	qu.	b.	p.
(33)	64	3	4	3
	134	4	7	2
	84	2	4	1
	56	3	2	3
	84	3	0	1
	98	4	6	0
	87	1	5	3

	l.	qu.	b.	p.
(34)	567	4	3	2
	89	2	3	1
	97	1	4	2
	65	3	7	1
	83	2	5	3
	38	1	4	1
	54	2	3	2

	b.	p.	g.	qu.
(35)	86	3	1	1
	54	2	1	0
	89	2	0	3
	98	3	1	0
	87	1	0	2
	74	2	1	1
	54	3	2	1

	b.	p.	g.	qu.
(36)	132	3	0	1
	56	2	1	0
	83	3	1	3
	54	1	1	0
	64	2	1	2
	56	3	0	3
	84	2	1	2

Section 10.

	d.	h.	m.	sec.
(37)	98	20	52	34
	87	19	31	52
	74	18	55	63
	49	17	47	54
	96	16	59	30

	d.	h.	m.	sec.
(38)	88	19	16	56
	87	17	18	44
	78	15	20	53
	76	13	35	21
	69	11	46	13

	m.	w.	d.	h.
(39)	75	3	6	4
	58	0	5	15
	87	2	4	18
	134	1	3	19
	234	3	2	21

	m.	w.	d.	h.
(40)	84	3	5	20
	47	0	3	22
	78	2	2	23
	135	1	0	7
	567	3	1	9

Section 11.

	qu.	lbs.	oz.	dr.
(41)	135	23	15	13
	49	26	13	14
	8	13	9	7
	7	19	8	9
	89	17	7	4
	97	13	11	5
	75	10	2	11

	qu.	lbs.	oz.	dr.
(42)	389	27	14	9
	46	21	7	4
	64	19	10	7
	385	16	13	10
	496	13	15	12
	685	9	0	13
	574	7	12	5

	t.	cwt.	qu.	lbs.
(43)	346	19	3	24
	632	17	2	23
	278	15	1	15
	863	13	0	17
	589	10	1	18
	975	9	2	13
	537	8	3	14

	t.	cwt.	qu.	lbs.
(44)	91	18	3	19
	84	15	1	20
	73	10	0	17
	77	5	3	15
	78	1	0	11
	89	0	1	5
	94	19	3	2

Section 12.

	lbs.	oz.	dwt.	gr.
(45)	889	11	19	23
	478	9	13	18
	876	8	15	17
	987	5	17	13
	567	7	15	14
	8	10	13	19
	98	7	10	18
	376	3	9	13
	475	1	8	14

	lbs.	oz.	dwt.	gr.
(46)	847	9	19	14
	737	8	4	9
	987	7	2	8
	783	5	0	7
	634	11	14	9
	445	10	18	14
	567	9	19	15
	789	8	16	17
	104	7	14	18

	lbs.	oz.	dr.	sc.
(47)	543	11	7	2
	987	9	5	1
	876	6	6	0
	400	7	4	1
	806	0	0	2
	907	5	2	0
	4	1	1	1
	48	2	3	2
	897	4	4	1

	oz.	dr.	scr.	gr.
(48)	867	7	1	17
	543	5	0	16
	55	4	0	13
	674	3	1	10
	832	2	0	9
	897	0	1	8
	798	1	1	7
	98	3	0	6
	198	4	1	5

Section 13.

	p.	yds.	ft.	in.
(49)	58	2	2	11
	84	3	0	9
	78	4	1	8
	97	5	1	7
	74	4	0	6
	83	3	2	2
	92	2	1	1

	p.	yds.	ft.	in.
(50)	74	4	1	10
	83	5	0	9
	94	3	2	7
	57	1	0	3
	8	0	1	4
	9	2	2	2
	89	1	1	9

Section 13 *(continued)*.

	m.	f.	yds.	ft.
(51)	22	7	13	2
	83	5	141	1
	94	3	156	0
	56	2	83	2
	89	0	14	1
	94	1	64	0
	48	3	165	1

	m.	f.	yds.	ft.
(52)	132	6	132	2
	846	5	155	1
	793	0	56	0
	843	3	84	2
	143	1	94	1
	157	2	132	0
	768	3	156	1

Section 14.

	a.	r.	p.	yds.
(53)	847	3	19	24
	132	2	39	5
	594	0	28	18
	98	1	17	17
	87	2	26	15
	137	3	18	24

	a.	r.	p.	yds.
(54)	56	1	37	29
	67	0	4	26
	867	0	5	13
	576	2	19	19
	834	3	36	17
	498	1	37	13

	p.	yds.	ft.	ins.
(55)	934	23	7	15
	876	29	8	132
	93	17	3	114
	38	16	5	101
	84	18	2	98
	79	26	1	76

	p.	yds.	ft.	ins.
(56)	732	26	7	132
	832	11	6	14
	198	18	5	132
	846	9	3	136
	678	7	1	112
	784	6	0	98

Section 15.

	yds.	ft.	ins.
(57)	846	26	132
	567	13	1523
	834	18	1672
	987	19	846
	789	24	534

	yds.	ft.	ins.
(58)	897	26	1727
	789	21	1710
	678	25	178
	357	19	856
	789	12	946

	l.	qu.	b.	p.
(59)	845	4	7	3
	567	3	5	2
	675	1	6	1
	754	2	3	0
	345	0	2	2

	l.	qu.	b.	p.
(60)	567	3	6	2
	839	2	5	1
	987	1	3	3
	734	4	7	1
	567	3	2	0

Section 16.

	d.	h.	m.	s.
(61)	834	19	54	34
	567	23	17	56
	894	17	19	13
	567	12	45	15
	783	13	32	13
	104	15	44	14
	567	9	53	17
	704	8	36	15
	200	2	11	16
	506	16	12	19

	m.	w.	d.	h.
(62)	867	3	6	23
	755	2	3	13
	208	1	2	12
	804	0	0	10
	567	1	1	9
	708	3	3	8
	897	2	2	7
	387	1	1	3
	467	2	4	5
	789	3	5	6

Section 16 (*continued*).

	£.	s.	d.
(63)	1367	15	6½
	467	14	8¾
	567	14	9½
	813	15	10½
	2131	17	11¼
	5689	19	10¾
	878	9	5½
	765	8	6
	1346	11	7¾
	7893	13	8¾

	£.	s.	d.
(64)	3467	15	7½
	5678	18	3½
	4328	17	7¼
	9376	16	8¾
	5678	19	9½
	3287	13	5¾
	5678	10	7¼
	1038	9	9½
	8070	3	11¾
	3798	4	10½

Section 17.

	t.	cwt.	qr.	lbs.
(65)	785	11	3	23
	346	17	1	11
	643	3	0	10
	302	15	2	19
	891	17	1	13
	732	19	3	25
	832	1	0	24
	437	3	1	15

	qu.	lbs.	oz.	dr.
(66)	784	22	14	13
	478	11	11	15
	930	23	9	5
	407	26	7	7
	538	11	8	8
	356	0	0	3
	407	15	13	2
	530	25	14	11

	lbs.	oz.	dwt.	gr.
(67)	567	11	19	23
	768	10	13	13
	890	11	9	14
	407	8	7	17
	538	7	3	8
	467	5	2	9
	579	0	0	3
	987	4	2	2

	lbs.	oz.	dr.	sc.
(68)	346	3	3	1
	475	7	5	0
	580	8	7	2
	697	11	3	0
	832	10	4	1
	491	11	0	2
	572	7	2	0
	834	8	1	2

Section 18.

	p.	yds.	ft.	in.
(69)	347	4	1	3
	568	0	0	1
	890	1	0	4
	405	2	2	11
	187	3	1	9
	780	5	1	7
	897	4	0	3
	457	3	2	7
	856	2	1	5
	532	1	2	8

	a.	r.	p.	yds.
(70)	375	1	37	17
	489	0	32	15
	596	3	27	13
	785	2	23	24
	346	1	13	25
	576	0	17	10
	834	1	14	9
	946	2	8	8
	756	3	7	7
	834	1	9	3

Section 18 (*continued*).

	l.	qu.	b.	p.
(71)	867	4	7	2
	534	1	5	1
	672	0	3	0
	784	2	1	3
	489	3	0	1
	704	0	2	0
	867	1	4	2
	754	3	6	3
	867	4	2	3
	849	3	3	2

	m.	w.	d.	h.
(72)	567	1	6	23
	843	0	3	11
	575	2	4	14
	678	3	2	9
	891	1	1	8
	745	3	0	7
	556	2	3	14
	678	0	4	19
	913	1	5	22
	487	2	6	11

Section 19.

	£.	*s.*	*d.*
(73)	3467	13	4½
	4307	14	5½
	5078	15	6¾
	3056	16	8¼
	5357	19	9¾
	8437	9	11¾
	1348	8	10½
	5326	10	5½
	7583	17	6¼
	8347	13	7¼
	5367	15	8½

	cwt.	lbs.	oz.	dr.
(74)	367	111	15	13
	421	18	13	11
	567	56	11	9
	785	65	9	8
	987	78	7	7
	784	87	5	5
	934	94	3	6
	349	96	0	2
	407	35	12	13
	567	24	8	12
	831	11	6	11

	lbs.	oz.	dwt.	gr.
(75)	345	10	19	23
	567	3	17	21
	798	5	15	19
	809	7	14	17
	567	8	8	15
	840	11	6	18
	543	0	4	16
	575	3	3	14
	835	5	0	12
	475	7	17	8
	897	8	18	6

	a.	r.	p.	yds.
(76)	314	0	37	17
	567	1	14	27
	403	0	24	29
	579	2	27	25
	837	3	33	23
	589	1	35	20
	987	2	25	15
	347	3	4	13
	567	0	5	9
	914	1	10	8
	534	2	17	7

SUBTRACTION.

Section 1.

	£.	s.	d.		£.	s.	d.		£.	s.	d.		£.	s.	d.
(1)	342	15	6½	(2)	834	17	8¾	(3)	832	10	2¾	(4)	876	17	6¼
	129	14	2¼		598	18	9¼		489	14	9¼		498	19	11¾

Section 2.

(5)	326	11	4¼	(6)	567	15	11¼	(7)	812	12	5¼	(8)	1913	15	5
	187	18	9¾		483	17	9¾		798	19	7¾		832	17	9¼

Section 3.

(9)	567	0	3½	(10)	856	11	7¼	(11)	960	0	0¾	(12)	346	5	4½
	198	18	9¾		798	14	9½		878	2	3½		94	18	9¾

Section 4.

(13)	834	15	7½	(14)	347	9	4¾	(15)	836	5	7½	(16)	567	12	10½
	698	19	9¾		189	11	10½		498	9	11¾		478	15	11¾

Section 5.

	t.	cwt.	qr.	lbs.		t.	cwt.	qr.	lbs.
(17)	346	10	1	23	(18)	560	0	2	13
	189	13	2	27		478	16	3	24

	qu.	lbs.	oz.	dr.		qu.	lbs.	oz.	dr.
(19)	837	14	7	11	(20)	710	13	7	10
	589	23	9	14		482	25	9	15

Section 6.

	lbs.	oz.	dwt.	gr.		lbs.	oz.	dwt.	gr.
(21)	734	5	12	14	(22)	754	11	17	21
	546	8	17	23		548	5	19	23

	lbs.	oz.	dwt.	gr.		lbs.	oz.	dwt.	gr.
(23)	430	1	15	7	(24)	567	10	11	15
	157	8	18	15		489	11	15	21

Section 7.

	lbs.	oz.	dr.	sc.		lbs.	oz.	dr.	sc.
(25)	346	7	1	1	(26)	567	3	0	0
	157	9	7	2		478	8	5	2

	oz.	dr.	sc.	gr.		oz.	dr.	sc.	gr.
(27)	345	4	1	11	(28)	567	2	0	12
	156	6	2	15		178	7	2	17

Section 8.

	p.	yds.	ft.	ins.		p.	yds.	ft.	ins.
(29)	523	4	1	7	(30)	321	4	0	1
	456	2	2	9		145	5	2	11

	m.	f.	yds.	ft.		m.	f.	yds.	ft.
(31)	132	4	124	2	(32)	232	5	111	1
	79	7	210	1		156	7	124	2

Section 9.

	a.	r.	p.	yds.
(33)	472	1	19	17
	189	3	37	24

	a.	r.	p.	yds.
(34)	576	0	32	17
	489	2	37	24

	p.	yds.	ft.	ins.
(35)	837	11	7	111
	679	17	8	140

	p.	yds.	ft.	in.
(36)	752	17	3	10
	478	23	5	117

Section 10.

	l.	qu.	b.	p.
(37)	734	2	4	2
	545	4	7	3

	l.	qu.	b.	p.
(38)	563	1	1	1
	179	3	5	3

	b.	p.	g.	qua.
(39)	314	2	0	2
	136	3	1	3

	b.	p.	g.	qua.
(40)	567	1	1	1
	378	2	0	2

Section 11.

	m.	d.	h.	m.
(41)	478	3	17	34
	199	23	21	54

	w.	d.	h.	m.
(42)	374	3	9	13
	197	5	17	34

	d.	h.	m.	sec.
(43)	784	17	17	15
	697	23	36	45

	d.	h.	m.	sec.
(44)	178	1	0	19
	99	20	13	29

Section 12.

	£.	*s.*	*d.*
(45)	1,567	15	6½
	679	19	8¾

	£.	*s.*	*d.*
(46)	3,456	10	9¾
	1,569	14	11

(47)	5,678	9	8
	1,789	12	9¾

(48)	3,467	8	9¼
	1,579	11	10¾

Section 13.

	t.	cwt.	qu.	lbs.
(49)	876	11	1	23
	487	15	3	26

	t.	cwt.	qu.	lbs.
(50)	567	10	2	14
	378	15	1	10

	qu.	lbs.	oz.	dr.
(51)	567	14	8	11
	178	24	11	7

	qu.	lbs.	oz.	dr.
(52)	785	1	13	7
	396	15	10	14

Section 14.

	lbs.	oz.	dwt.	gr.
(53)	356	7	17	21
	167	9	19	23

	lbs.	oz.	dwt.	gr.
(54)	1346	5	11	7
	757	7	12	18

	lbs.	oz.	dwt.	gr.
(55)	2346	1	14	5
	1578	5	19	8

	lbs.	oz.	dwt.	gr.
(56)	3780	0	5	9
	1894	5	13	17

Section 15.

	lbs.	oz.	dr.	sc.
(57)	534	7	4	1
	347	11	7	2

	lbs.	oz.	dr.	sc.
(58)	532	1	5	0
	445	5	7	1

	oz.	dr.	sc.	gr.
(59)	340	1	1	14
	151	5	2	17

	oz.	dr.	sc.	gr.
(60)	567	2	0	1
	178	7	1	15

Section 16.

	m.	f.	p.	yds.
(61)	357	1	27	3
	178	5	35	4

	m.	f.	p.	yds.
(62)	471	2	11	1
	183	7	21	5

	p.	yds.	ft.	ins.
(63)	354	4	1	7
	167	5	2	8

	p.	yds.	ft.	ins.
(64)	147	1	0	7
	58	2	2	11

Section 17.

	a.	r.	p.	yds.
(65)	142	1	14	13
	87	3	28	24

	a.	r.	p.	yds.
(66)	374	0	19	21
	195	1	39	28

	p.	yds.	ft.	ins.
(67)	567	13	5	130
	189	24	8	137

	p.	yds.	ft.	ins.
(68)	574	1	2	111
	185	27	7	131

Section 18.

	l.	qu.	b.	p.
(69)	350	1	4	1
	162	4	7	3

	l.	qu.	b.	p.
(70)	743	0	1	2
	156	3	3	3

	b.	p.	g.	qt.
(71)	510	1	1	1
	323	3	0	3

	b.	p.	g.	qt.
(72)	621	0	0	0
	232	2	1	2

Section 19.

	mo.	w.	d.	h.
(73)	572	1	1	11
	287	3	3	22

	mo.	w.	d.	h.
(74)	321	2	2	10
	132	3	4	15

	d.	h.	m.	sec.
(75)	530	11	24	13
	187	19	36	23

	d.	h.	m.	sec.
(76)	732	1	5	15
	543	15	13	24

Section 20.

	cwt.	lbs.	oz.	dr.
(77)	520	37	5	7
	278	55	8	13

	lbs.	oz.	dwt.	gr.
(78)	243	1	15	21
	87	7	17	23

	oz.	dr.	sc.	gr.
(79)	567	1	1	11
	178	4	2	15

	p.	yds.	ft.	ins.
(80)	530	3	1	3
	341	5	2	5

Section 21.

	a.	r.	p.	yds.
(81)	156	1	14	13
	87	3	28	15

	l.	qu.	b.	p.
(82)	357	1	3	1
	168	4	5	2

	mo.	w.	d.	h.
(83)	810	0	1	11
	576	1	3	17

	d.	h.	m.	sec.
(84)	834	5	11	14
	756	9	34	27

COMPOUND MULTIPLICATION AND DIVISION.

Section 1.

Find the Value of

£. s. d.
(1) 45 16 6 × 3
£. s. d.
(2) 845 17 7½ × 4
£. s. d.
(3) 567 18 3¾ × 6

Section 2.

(4) 314 7 8¾ × 8
(5) 567 10 4¾ × 9
(6) 36 4 3½ × 3
(7) 945 6 7½ × 7

Section 3.

(8) 227 10 11 ÷ 4
(9) 419 18 11½ ÷ 5
(10) 394 10 1¼ ÷ 7
(11) 417 9 4½ + 5
(12) 162 9 9¾ + 11

Section 4.

(13) 186 17 7½ × 12
(14) 304 13 4½ × 14
(15) 506 7 8½ × 15
(16) 304 17 8¾ × 17
(17) 506 17 8¾ × 16
(18) 8030 0 5¼ × 18

Section 5.

(19) 2,431 10 11¾ + 17
(20) 2,242 11 6 + 12
(21) 106,537 1 6½ ÷ 19

Section 6.

(22) 8,030 17 0½ × 11
(23) 5,067 14 8½ × 13
(24) 5,067 5 8½ × 22
(25) 304 17 8½ × 34
(26) 506 7 8½ × 73
(27) 346 17 9½ × 97

Section 7.

(28) 178,013 12 11 ÷ 50
(29) 32,083 1 8½ ÷ 37
(30) 61,885 8 7½ + 109

Section 8.

(31) 190,333 16 2¼ ÷ 201
(32) 153,951 6 0 ÷ 304
(33) 384,390 4 6½ + 406

Section 9.

(34) 3,406 18 8¼ × 47
(35) 839 10 10½ × 76
(36) 567 15 7½ × 43
(37) 304 6 7½ × 109
(38) 627 3 4¼ × 27
(39) 134 6 8 × 31

Section 10.

£ s. d.
(40) 3,046 18 3¾ ÷ 5,067

£ s. d.
(41) 30,467 15 7¾ ÷ 3,456

(42) 34,678 15 8¼ ÷ 1,416

Section 11.

acres. r. p.
(43) 31 2 6 × 97

acres. r. p. y.
(44) 7 1 36 15 × 122

yds. ft. ins.
(45) 5 7 136 × 86

Section 12.

£. s. d.
(46) 3,467 5 7½ ÷ 346

£. s. d.
(47) 8,367 16 9½ ÷ 437

£. s. d.
(48) 1,001 17 7¾ ÷ 845

Section 13.

m. f. p. yds.
(49) 2 4 35 2 × 85

m. f. p. y.
(50) 132 1 13 1 × 145

yds. ft. ins.
(51) 132 2 11 × 99

Section 14.

£. s. d.
(52) 834 18 7¼ ÷ 341

£. s. d.
(53) 506 18 3½ ÷ 567

£. s. d.
(54) 304 19 9¾ ÷ 146

Section 15.

(55) 5,067 18 9 ÷ 345

(56) 5,306 17 7¾ ÷ 506

t. cwt. qr. lbs.
(57) 2 15 2 24 ÷ 37

Section 16.

t. cwt. qr.
(58) 2 13 2 × 99

£. s. d.
(59) 346 17 8½ × 145

qu. lbs. oz. dr.
(60) 34 14 13 12 × 56

lbs. oz. dwt. gr.
(61) 5 10 12 10 × 123

lbs. oz. dr. sc. gr.
(62) 54 7 5 2 13 × 78

Section 17.

yds. ft. ins.
(63) 8 2 7 × 37

a. r. p. yds.
(64) 7 2 39 4 × 47

l. q. b. p.
(65) 8 3 4 3 × 79

m. w. d. h.
(66) 13 3 4 11 × 89

Section 18.

	t.	cwt.	qr.	lbs.	
(67)	345	14	2	11	× 74

	t.	cwt.	qr.	lbs.	
(68)	567	13	1	27	× 89

	a	r.	p.	
(69)	345	2	39	× 56

Section 19.

	a.	r.	p.	
(70)	302	1	24	× 34

	c. yds.	c. ft.	c. ins.	
(71)	346	24	132	× 37

	c. yds.	c. ft.	c. ins.	
(72)	146	14	146	× 28

Section 20.

	w.	d.	h.	m.	
(73)	74	6	13	14	× 97

	w.	d.	h.	m.	
(74)	132	3	20	54	× 97

	lbs.	oz.	dwt.	gr.	
(75)	133	5	2	12	× 32½

Section 21.

	lbs.	oz.	dwt.	gr.	
(76)	142	7	15	21	× 56⅛

	l.	q.	b.	p.	g.	
(77)	64	3	4	3	1	× 78

	l.	q.	b.	p.	g.	
(78)	124	2	5	2	0	× 17

Section 22.

	lbs.	oz.	dr.	sc.	gr.	
(79)	132	5	7	2	18	× 33½

	lbs.	oz.	dr.	sc.	gr.	
(80)	12	11	5	1	10	× 45¼

	t.	cwt.	qrs.	lbs.	
(81)	737	14	2	24	× 32

Section 23.

	a.	r.	p.	
(82)	45	3	32	× 147

	c. yds.	c. ft.	c. ins.	
(83)	132	21	346	× 47

	w.	d.	h.	m.	
(84)	142	1	23	32	× 117

Section 24.

	lbs.	oz.	dwt.	gr.	
(85)	122	3	17	19	× 74⅛

	l.	q.	b.	p.	g.	
(86)	104	4	7	1	1	× 65

	lbs.	oz.	dr.	sc.	gr.	
(87)	15	10	6	0	15	× 78⅓

Section 25.

	t.	cwt.	qr.	lbs.	
(88)	234	7	3	14	× 5¼

	t.	cwt.	qr.	lbs.	
(89)	132	5	0	24	× 7⅕

	t.	cwt.	qr.	lbs.	
(90)	345	17	2	3	× 9⅛

Section 26.

£ s. d.
(91) 34 7 6½ × 32⅓

£. s. d.
(92) 56 5 3¾ × 89¼

£. s. d.
(93) 154 3 7½ × 78⅓

Section 27.

lbs. oz. dwt. gr.
(94) 567 3 32 19 × 7⅛

lbs. oz. dwt. gr.
(95) 834 5 14 15 × 8⅐

lbs. oz. dwt. gr.
(96) 432 7 7 8 × 12⅙

Section 28.

lbs. oz. dr. sc. gr.
(97) 578 6 5 2 14 × 15⅐

lbs. oz. dr. sc. gr.
(98) 57 5 6 1 15 × 83⅛

lbs. oz. dr. sc. gr.
(99) 89 7 1 2 13 × 26⅕

Section 29.

(100) If a man receive £. 3 s. 10 d. 8¼ per month, how much ought he to receive for 23 months ?

(101) Divide £. 98,765 s. 10 d. 3¾ equally amongst 95 men.

(102) Divide a prize of £. 4,567 s. 18 d. 7¾ equally amongst a ship's crew of 567 men.

Section 30.

(103) If a man receives £. 6 s. 3 d. 9½ for one month, how much will 432 men receive ?

(104) The wages of one man are £. 1 s. 5 d. 6½, find the wages of 149.

(105) A farmer sold at a fair 243 cows at £. 11 s. 13 d. 4 each, find the amount.

Section 31.

(106) Divide £. 3,467 s. 15 d. 3¼ by 104. (107) Divide £. 5,678 s. 13 d. 4 by 314.

(108) A tradesman sold goods at £. 34 s. 17 d. 8¾ for 7, find the price of 134.

Section 32.

£. s. d.
(109) 61,733 18 6 + 132

£. s. d.
(110) 52,727 7 6 + 152

£. s. d.
(111) 126,869 16 2 + 152

Section 33.

£. s. d.
(112) 98,794 2 4½ + 174

£. s. d.
(113) 27,841 14 0½ + 202

£. s. d.
(114) 8,379 17 9¾ + 57

Section 34.

t. cwt. qr. lbs.
(115) 738 3 1 25 + 13

t. cwt. qr. lbs.
(116) 2,977 5 3 9 + 19

t. cwt. qr. lbs.
(117) 3,242 1 0 20 + 37

Section 35.

lbs. oz. dwt. gr.
(118) 345 8 5 16 + 314

lbs. oz. dwt. gr.
(119) 5,678 3 11 14 + 567

lbs. oz. dwt. gr.
(120) 345 7 8 9 + 467

Section 36.

lbs. oz. dr. sc. gr.
(121) 20,466 9 4 0 6 + 59

lbs. oz. dr. sc. gr.
(122) 2,379 5 3 2 17 + 69

lbs. oz. dr. sc. gr.
(123) 30,452 2 3 0 11 + 89

Section 37.

m. f. p. yd.
(124) 2,665 2 31 ½ + 58

m. f. p. yds.
(125) 4,402 7 36 3 + 78

m. f. p. yds.
(126) 3,544 7 5 4½ + 104

Section 38.

a. r. p. yds.
(127) 536 0 9 26½ + 15

a. r. p. yds.
(128) 40,089 1 37 18¾ + 78

a. r. p. yds.
(129) 27,364 2 21 5 + 87

Section 39.

c. yds. c. ft. c. ins.
(130) 3,872 26 1272 + 111

c. yds. c. ft. ins.
(131) 8,320 23 862 + 146

c. yds. c. ft. c. ins.
(132) 9,671 25 1,380 + 73.

Section 40.

s. yds. s. ft. s. in. s. yds. s. ft. s. in.
(133) 81,324 4 132 ÷ 157 (134) 35,529 3 126 ÷ 143

s. yds. s. ft. s. in.
(135) 59,375 6 121 ÷ 115

Section 41.

d. h. m. sec. d. h. m. sec.
(136) 9,030 12 55 15 ÷ 133 (137) 8,344 1 46 5 ÷ 145

d. h. m. sec.
(138) 33,361 15 25 16 ÷ 106

Section 42.

l. qu. b. p. l. qu. b. p.
(139) 15,536 4 2 3 ÷ 117 (140) 22,259 2 7 26 ÷ 153

l. qu. b. p.
(141) 9,847 4 0 3 ÷ 57

Section 43.

£. s. d.
(142) Divide 61,733 18 6 equally amongst 132 men.
(143) Divide 52,727 7 6 equally amongst 152 men.
(144) Divide 126,869 16 2 equally amongst 152 men.

Section 44.

£ s. d.
(145) Divide a prize of 27,841 14 0½ equally amongst 202 men.
(146) Divide a prize of 98,794 2 4½ equally amongst 174 men.
(147) Divide a prize of 3,379 17 9¾ equally amongst 75 men.

Section 45.

£. s. d. *£. s. d.*
(148) 3 17 6 × 6 ÷ 9 (149) 5 13 4 × 4 ÷ 7
(150) 16 13 5½ × 5 ÷ 8 (151) 15 14 7½ × 11 ÷ 12

Section 46.

£. s. d. *£. s. d.*
(152) 132 13 4½ × 7 ÷ 5 (153) 56 14 8¾ × 3 ÷ 4
(154) 83 13 9¼ × 5 ÷ 6 (155) 134 10 10½ × 6 ÷ 7

Section 47.

£. s. d. *£. s. d.*
(156) 153 3 3½ × 7 ÷ 8 (157) 345 6 8½ × 9 ÷ 11
(158) 467 5 5¾ × 11 ÷ 9 (159) 346 7 7½ × 12 ÷ 10

Section 48.

t. cwt. qr. lbs.
(160) The weight of 8 iron beams is 5 13 3 15, find the weight of 56 such beams.

lbs. oz. dwt. gr.
(161) The weight of 15 gold bars is 13 9 13 14, find the weight of 135 such bars.

t. cwt. qr. lbs.
(162) The weight of 26 beams of timber is 5 7 1 24, find the weight of 364 such beams.

Section 49.

(163) Divide £23 13*s.* 8*d.* by £3 7*s.* 8*d.* (Although the question multiply £23 13*s.* 8*d.* by £3 7*s.* 8*d.* is perfectly absurd, still the question divide £23 13*s.* 8*d.* by £3 7*s.* 8*d.* is quite consistent, and only signifies how many times does £23 13*s.* 8*d.* contain £3 7*s.* 8*d.* Reduce the divisor and dividend to the lowest denomination and then divide, the result will be the quotient.)

	£.	*s.*	*d.*		£.	*s.*	*d.*
(164)	771	8	2½	÷	45	7	6½
(165)	3118	8	10¾	÷	84	5	7¾
(166)	4098	9	3	÷	31	0	11¾

	t.	cwt.	qr.	lbs.		t.	cwt.	qr.	lb.
(167)	33	13	3	5	÷	3	14	3	13

	t.	cwt.	qr.	lbs.	oz.		t.	cwt.	qr.	lbs.	oz.
(168)	2406	19	3	22	6	÷	15	6	2	13	14

Section 50.

	lbs.	oz.	dwts.	gr.		lbs.	oz.	dwts.	gr.
(169)	281	5	6	12	÷	15	7	12	14
(170)	2045	11	0	7	÷	14	3	13	17

	a.	r.	p.		a.	r.	p.
(171)	1070	3	17	÷	34	2	7

	t.	cwt.	qr.	lbs.	oz.		t.	cwt.	qr.	lbs.	oz.
(172)	14843	13	2	25	2	÷	121	13	1	15	13

Section 51.

	£.	*s.*	*d.*		£.	*s.*	*d.*
(173)	5440	16	6	÷	34	17	6½

	lbs.	oz.	dwts.	gr.		lbs.	oz.	dwts.	gr.
(174)	1418	8	5	9	÷	16	3	13	15

	lbs.	oz.	dr.	sc.	gr.		lbs.	oz.	dr.	sc.	gr.
(175)	1958	4	2	1	12	÷	18	9	7	2	3

	m.	f.	p.	yds.		m.	f.	p.	yds.
(176)	1765	0	33	4½	÷	7	3	33	2

Section 52.

s.y. s.f. s.in. s.y. s.f. s.in.
(177) 1953 1 136 ÷ 34 7 131

t. cwt. qr. lbs. oz. dr. t. cwt. qr. lbs. oz. dr.
(178) 4222 2 3 24 5 6 ÷ 31 14 3 17 13 14

lbs. oz. dwts. gr. lbs. oz. dwts. gr.
(179) 22152 3 16 8 ÷ 132 7 15 16

a. r. p. y. a. r. p. y.
(180) 1952 1 1 29¾ ÷ 34 3 17 27

TO FIND THE GREATEST COMMON MEASURE.

One number measures another when it divides it exactly: thus, 6 measures 18, because it will divide it exactly.

When a number measures two or more numbers, it is called a common measure of those numbers: thus, 6 is a common measure of 12, 18, 24, &c.

The greatest number that will measure two or more numbers is called the greatest common measure of those numbers: thus, 2 is a common measure of 12, 18, 24, &c.; and so is 6, which is the greatest.

Find the greatest Common Measure of the following Numbers.

Section 1.

(1) 136, 360 (2) 913, 594 (3) 1445, 1105 (4) 247, 377
(5) 1003, 1343 (6) 442, 2834.

Section 2.

(7) 105, 409 (8) 3706, 918 (9) 507, 819 (10) 5992, 46984
(11) 27318, 44631 (12) 3430, 8526.

Section 3.

(13) 741, 3341 (14) 1305, 2805 (15) 2489, 13179 (16) 13689, 21843
(17) 4158, 4698 (18) 3858, 4710.

Section 4.

(19) 3868, 13836 (20) 3969, 5495 (21) 10274, 16929
(22) 1701, 2367 (23) 4170, 4785 (24) 5770, 5862.

Section 5.

(25) 172975, 504845 (26) 34822, 38594 (27) 747, 873
(28) 1957, 2033 (29) 1624, 2440.

Section 6.

(30) 140, 196, 268 (31) 135, 153, 171 (32) 147, 161, 203
(33) 114, 138, 234.

Section 7.

(34) 199, 377, 637 (35) 1494, 1566, 1782 (36) 265, 385, 495
(37) 1683, 1287, 1921.

Section 8.

(38) 285, 185, 235 (39) 1096, 1272, 1624 (40) 1144, 1496, 1672
(41) 464, 752, 1680.

TO FIND THE LEAST COMMON MULTIPLE.

One number is a multiple of another when it contains it an exact number of times : thus 16 is a multiple of 4, as well as 2 and 8.

When a number contains each of two or more numbers an exact number of times, it is a *common multiple* of those numbers : thus, 18 being a multiple of each of 3, 9, is a *common multiple* of 3 and 9.

The least number that contains each of two or more numbers is the *least common multiple* of those numbers : thus, 24 is the common multiple of 2, 4, 8 ; so are 16 and 8 ; but 8 is the least *common multiple.*

Find the least Common Multiple of the following Numbers.

Section 1.

(1) 3, 9, 21 (2) 5, 25, 40 (3) 6, 18, 26 (4) 5, 15, 50
(5) 9, 8, 4, 27

Section 2.

(6) 8, 15, 24 (7) 24, 26, 16 (8) 9, 27, 21 (9) 13, 26, 24
(10) 9, 22, 36

Section 3.

(11) 2, 8, 24, 48 (12) 16, 22, 28, 11 (13) 15, 20, 18, 24
(14) 13, 39, 14, 42

Section 4.

(15) 12, 14, 18, 20, 22 (16) 13, 15, 17, 19, 34, 57
(17) 24, 28, 26, 34, 38, 40

Section 5.

(18) 8, 10, 12, 18, 24, 36, 48 (19) 24, 26, 30, 34, 38, 42, 50
(20) 15, 18, 21, 24, 27, 32

Section 6.

(21) 16, 20, 26, 39, 45 (22) 17, 68, 34, 54
(23) 18, 38, 48, 58, 68

The solutions of questions such as the following depend on the principle of finding the least common multiple of several numbers.

(24) Three travellers, A, B, C, set out together to travel the same way round an island; A can travel round it in 12 days, B in 16 days, and C in 18 days. In how many days will they all come together again, and how many times will they have travelled round the island? It is only necessary to find the least common multiple of 12, 16, and 18.

MISCELLANEOUS EXAMPLES.

Section 1.

(1) Multiply 4670409 by 31416.

(2) Divide 3225070309545 by 56789.

(3) Reduce 467856 pounds to tons.

(4) Reduce $\overset{\text{t.}}{56}\ \overset{\text{cwt.}}{13}\ \overset{\text{qu.}}{3}\ \overset{\text{lbs.}}{4}$ to ounces.

(5) Find the difference between $\overset{\text{lbs.}}{146}\ \overset{\text{oz.}}{8}\ \overset{\text{dwt.}}{7}\ \overset{\text{gr.}}{16}$ and $\overset{\text{lbs.}}{89}\ \overset{\text{oz.}}{10}\ \overset{\text{dwt.}}{11}\ \overset{\text{gr.}}{18}$.

(6) Multiply $\overset{\text{lbs.}}{34}\ \overset{\text{oz.}}{3}\ \overset{\text{dr.}}{13}$ by 29¼.

(7) Divide $\overset{\text{lbs.}}{18332}\ \overset{\text{oz.}}{8}\ \overset{\text{dwt.}}{8}\ \overset{\text{gr.}}{9}$ by 17.

(8) Find the greatest common measure of 22976 and 506368.

(9) Reduce 19½ miles per hour to feet per second.

(10) Reduce 31½ feet per second to miles per hour.

(11) A body moves at the rate of 34 miles per hour; find its velocity.

Section 2.

(1) Multiply 3456784 by 8067.

(2) Divide 368005733615 by 90467.

(3) Reduce 346785 farthings to pounds.

(4) Reduce $\overset{\text{£.}}{578}\ \overset{s.}{13}\ \overset{d.}{4\frac{1}{2}}$ to farthings.

(5) Find the greatest common measure of 6555 and 12768.

(6) Find the value of $\overset{\text{£.}}{4678}\ \overset{s.}{13}\ \overset{d.}{7\frac{1}{2}} - \overset{\text{£.}}{59}\ \overset{s.}{15}\ \overset{d.}{10\frac{3}{4}}$.

(7) Multiply $\overset{\text{£.}}{3141}\ \overset{s.}{13}\ \overset{d.}{7\frac{1}{2}}$ by 14½.

(8) Divide 33055 19 10¼ by 23⅓.

(9) Reduce 32¼ miles per hour to feet per second.

(10) Reduce 5¾ feet per second to miles per hour.

(11) A railway train moves at the rate of 52 miles per hour, find its velocity.

Section 3.

(1) Write the value of 804056070 in words.

(2) Divide 4976008209 by 8763.

(3) Reduce 1566669 drams to tons.

(4) Reduce $\overset{\text{lbs.}}{17}\ \overset{\text{oz.}}{10}\ \overset{\text{dwt.}}{19}\ \overset{\text{gr.}}{23}$ to grains.

(5) Find the value of 3 tons $- \overset{\text{t.}}{1}\ \overset{\text{cwt.}}{15}\ \overset{\text{qr.}}{2}\ \overset{\text{oz.}}{11}\ \overset{\text{dr.}}{9}$.

lbs. oz. dwt. gr.
(6) Find the value of 13 5 14 10 × 78.
(7) Find the greatest common measure of 174 and 714.
(8) Find the least common multiple of 8, 18, 42.
(9) Divide £4378 17 7¾ equally amongst 439 men.
(10) Reduce 52¾ miles per hour to feet per second.
(11) Reduce 2⅓ feet per second to miles per hour.
(12) A train moves at the rate of 32½ miles per hour, find its velocity.

Section 4.

(1) Write, in figures, four hundred and ten millions, thirty thousand, and ten.
(2) Multiply 58346 by 507.
(3) Find the value of 570430 × 93 ÷ 31.
lbs. lbs. oz. dr. sc. gr.
(4) Find the value of 17 — 13 1 5 2 14.
(5) Reduce 132 moidores to farthings.
(6) Reduce 5310 groats to sixpences.
m. f. p. yds. ft. in.
(7) Find the value of 4 3 32 3 2 3 × 154.
t. cwt. qr. lb.
(8) 132 beams of iron weigh 5617 11 2 14, find the weight of each beam.
(9) Find the greatest common measure of 581, 1029, 1323.
(10) Find the least common multiple of 24, 28, 36, 48, 56.
(11) Reduce 64½ miles per hour to feet per second.
(12) Reduce 4⅙ feet per second to miles per hour.
(13) A train moves at the rate of 44¼ miles per hour, find its velocity.

Section 5.

(1) Write in words the value of 3450607541.
(2) Find the value of 50705006 × 84 ÷ 7.
m. m. f. p. yds. ft. in.
(3) Find the value of 18 — 3 7 32 2 1 7 × 7.
(4) Reduce 172 marks to farthings.
(5) Reduce 853750 threepenny pieces to half-crowns.
r. p. yds.
(6) A landlord requires 2 31 27 of land for each of 65 tenants, find the whole quantity of land required.
a. r. p. yds.
(7) Divide 340 2 19 15 equally amongst 134 parishioners.
(8) Find the greatest common measure of 582, 3018, 4242.

(9) Find the least common multiple of 56, 58, 64, 76, 98.

(10) Reduce 52¼ miles per hour to feet per second.

(11) Reduce 10⅜ feet per second to miles per hour.

(12) A train moves at the rate of 55½ miles per hour, find its velocity.

Section 6.

(1) Write in figures, two hundred and four millions, one hundred and four thousand, and forty-nine.

(2) Find the value of 87594504 × 57678.

(3) Divide 1525726426 by 30467.

(4) Reduce 149618¼ square feet to acres.

(5) Reduce $\overset{\text{l.}}{132}\ \overset{\text{qu.}}{4}\ \overset{\text{b.}}{3}\ \overset{\text{p.}}{3}$ to gallons.

(6) Find the value of $\overset{\text{a.}}{8}\ \overset{\text{r.}}{2}\ \overset{\text{p.}}{32}\ \overset{\text{yds.}}{5} - \overset{\text{a.}}{4}\ \overset{\text{r.}}{3}\ \overset{\text{p.}}{39}\ \overset{\text{yds.}}{7}$.

(7) Multiply $\overset{\text{l.}}{31}\ \overset{\text{qu.}}{4}\ \overset{\text{b.}}{5}\ \overset{\text{p.}}{2}$ by 473.

(8) A year consists of $\overset{\text{d.}}{365}\ \overset{\text{h.}}{5}\ \overset{\text{m.}}{48}\ \overset{\text{s.}}{47}$, find the length of a week, 52 of which make a year.

(9) Find the greatest common measure of 228, 316, 388.

(10) Find the least common multiple of 84, 88, 98, 104.

(11) Reduce 9⅝ miles per hour to feet per second.

(12) Reduce 18¼ feet per second to miles per hour.

(13) A railway train moves at the rate of 32⅛ miles per hour; find its velocity.

Section 7.

(1) Write in words the value of 7040,600,751.

(2) There are 365 × 24 × 60 minutes in one year, how many have elapsed since the birth of Christ 1854 years.

(3) Divide 4286078964 square yards of land equally amongst 7548 villagers.

(4) Reduce 2504364 square yards to acres.

(5) Reduce $\overset{\text{m.}}{7}\ \overset{\text{w.}}{2}\ \overset{\text{d.}}{4}\ \overset{\text{h.}}{13}\ \overset{\text{m.}}{15}\ \overset{\text{s.}}{13}$ to seconds.

(6) Find value of $(\overset{\text{t.}}{5}\ \overset{\text{cwt.}}{17}\ \overset{\text{qr.}}{3}\ \overset{\text{lbs.}}{16}\ \overset{\text{oz.}}{13}\ \overset{\text{dr.}}{14} - \overset{\text{t.}}{2}\ \overset{\text{cwt.}}{19}\ \overset{\text{qr.}}{2}\ \overset{\text{lbs.}}{24}\ \overset{\text{oz.}}{15}\ \overset{\text{dr.}}{15}) \times 17$.

(7) A year consists of $\overset{\text{d.}}{365}\ \overset{\text{h.}}{5}\ \overset{\text{m.}}{48}\ \overset{\text{s.}}{47}$ find the length of 145 years.

(8) Divide $\overset{\text{a.}}{132}\ \overset{\text{r.}}{2}\ \overset{\text{p.}}{3}\ \overset{\text{s.yds.}}{14}\ \overset{\text{s.ft.}}{124}$ of land equally amongst 462 villagers.

(9) Find the greatest common measure of 399, 525, 2547.

(10) Four men, A, B, C, D, walking respectively at the rates of 12, 14, 16, 18 miles per day, start from the same place to travel in the same direction round an island 1008 miles in circumference, how many times will each travel round the island before they are together again?

(11) Reduce 37⅓ miles per hour to feet per second.

(12) Reduce 13⅜ feet per second to miles per hour.

(13) A ship sails at the rate of 45½ miles per hour; find its velocity.

Section 8.

(1) Write in figures, six thousand and four millions, seven hundred and nine thousand, and five.

(2) Find the value of 567805 × 347 × 73.

(3) Find the value of 31467004 ÷ 5004 × 4.

t. cwt. qr. lbs. oz. dr.
(4) Reduce 5 3 3 24 13 14 to drams.

lbs. oz. dwt. gr.
(5) Reduce 34 0 6 16 to pounds avoirdupois.

(6) Reduce 347603 feet to miles.

r. p. yds.
(7) One cottage has attached to it 1 34 27, how much land will suffice for 78 cottages?

£. s. d. £. s. d.
(8) Find the value of (362 7 6½ — 198 15 9¾) × 216 ÷ 8

a. r. p. yds.
(9) How many cottages can be built upon 11 2 15 3¼ of land,

r. p. yds.
each cottage occupying 1 14 17?

(10) Find the greatest common measure of 2814, 833, 3045.

(11) Find the least common multiple of 32, 44, 56.

(12) Three men travel round an island in 7, 9, 12 days respectively, they start together, when will they all meet together again? and how many times will each have been round?

(13) Reduce 15⅗ miles per hour to feet per second.

(14) Reduce 19⅘ feet per second to miles per hour.

(15) A train moves at the rate of 64½ miles per hour, find its velocity.

Section 9.

(1) Write out in words the value of 5090067345.

(2) Find the value of 34678 × 55 × 32.

(3) Find the value of 130375188084 ÷ 3478.

m. f. p. yds. ft.
(4) Reduce 4 7 24 3 2 to inches.

(5) Reduce 45359 grains to lbs. apothecaries weight.

£. s. d. £ s. d.
(6) Find the value of (135 3 7½ — 99 14 9¾) × 8 ÷ 9.

(7) Find the value of $(\overset{\text{r.}}{3}\ \ \overset{\text{p.}}{18}\ \ \overset{\text{sq. yds,}}{14}) \times 147$.

(8) There is $\overset{\text{a.}}{1}\ \ \overset{\text{r.}}{3}\ \ \overset{\text{p.}}{24}\ \ \overset{\text{yds.}}{17}$ of land attached to one house, how much would be required for 54 such houses ?

(9) The weight of 224 iron beams is $\overset{\text{t.}}{724}\ \ \overset{\text{cwt.}}{16}\ \ \overset{\text{qr.}}{1}\ \ \overset{\text{lbs.}}{14}$, required the weight of each.

(10) Find the greatest common measure of 2223, 2337, 4541.

(11) Find the least common multiple of 56, 88, 94, 108, and 124.

(12) Reduce 17½ miles per hour to feet per second.

(13) Reduce 23¼ feet per second to miles per hour.

(14) A train moves at the rate of 52½ miles per hour, find its velocity.

Section 10.

(1) Write in figures the value of two hundred and four millions, three thousand and fifty two.

(2) Find the value of 50647 × 3004 × 307.

(3) Find the value of 2189485268 ÷ 4321.

(4) Reduce 2782020 minutes to years.

(5) Reduce $\overset{\text{c. y.}}{8}\ \ \overset{\text{c. ft.}}{17}\ \ \overset{\text{c. in.}}{1048}$ to cubic inches.

(6) Reduce 7 lbs. avoirdupois to lbs. troy.

(7) Find the value of

$$(\overset{\text{t.}}{32}\ \ \overset{\text{cwt.}}{13}\ \ \overset{\text{lbs.}}{24}\ \ \overset{\text{oz.}}{13} - \overset{\text{t.}}{18}\ \ \overset{\text{cwt.}}{17}\ \ \overset{\text{qr.}}{3}\ \ \overset{\text{lbs.}}{27}\ \ \overset{\text{oz.}}{14}) \times 7 \div 8.$$

(8) A beam of iron weighs $\overset{\text{t.}}{9}\ \ \overset{\text{cwt.}}{13}\ \ \overset{\text{qr.}}{0}\ \ \overset{\text{lbs.}}{27}\ \ \overset{\text{oz.}}{13}\ \ \overset{\text{dr.}}{14}$; find the weight of 342.

(9) Divide $\overset{\pounds.}{108318}\ \ \overset{s.}{1}\ \ \overset{d.}{6}$ equally amongst 344 men.

(10) Find the greatest common measure of 747, 1035, 1971.

(11) Five men travel in the same direction round an island, which they can accomplish in 124, 144, 288, 36, and 72 hours respectively, they all start together, when will they be together again ?

(12) Reduce 11⅜ miles per hour to feet per second.

(13) Reduce 27½ feet per second to miles per hour.

(14) A train moves at the rate of 30½ miles per hour, find its velocity.

Section 11.

(1) Write in words the value of 50067000456.

(2) Find the value of 87694 × 4872 + 406.

(3) Divide 43983276576 by 86789.

(4) Reduce $\overset{\text{a.}}{3}\ \ \overset{\text{r.}}{2}\ \ \overset{\text{p.}}{24}\ \ \overset{\text{yds.}}{30}$ to square yards.

(5) Reduce $\overset{\text{lbs.}}{3}\ \overset{\text{oz.}}{11}\ \overset{\text{dwts.}}{5}\ \overset{\text{gr.}}{13}$ to grains.

(6) Reduce 3196 gallons to loads.

(7) A field yields $\overset{\text{l.}}{5}\ \overset{\text{qrs.}}{3}\ \overset{\text{b.}}{6}\ \overset{\text{p.}}{2}\ \overset{\text{g.}}{1}$ per acre, what will 832 acres yield ?

(8) Three hundred and fifty four men will convey $\overset{\text{s. yds.}}{2081}\ \overset{\text{s. ft.}}{3}\ \overset{\text{s. in.}}{72}$ of timber, how much does each man convey ?

(9) Each wagon conveys $\overset{\text{t.}}{5}\ \overset{\text{cwt.}}{6}\ \overset{\text{qr.}}{1}\ \overset{\text{lbs.}}{24}$ of coals, how many wagons will convey $\overset{\text{t.}}{298}\ \overset{\text{cwt.}}{2}$?

(10) Find the greatest common measure of 336, 942, 1422.

(11) Six men travel in the same direction round an island, which they accomplish in 8, 11, 22, 16, 32, 33 days respectively; they all start together, find the position of the two last when the first four are together, and how many times each will go round before they are all together.

(12) Reduce 18¼ miles per hour to feet per second.

(13) Reduce 34⅜ feet per second to miles per hour.

(14) A train moves at the rate of 34¼ miles per hour, find its velocity.

Section 12.

(1) Write in figures the value of five thousand and four millions, one hundred and three thousand, and eighty four.

(2) Find the value of 87694 × 4872 ÷ 406.

(3) Divide 2027405400 by 40008.

(4) Reduce $\overset{\text{lbs.}}{5}\ \overset{\text{oz.}}{11}\ \overset{\text{dwts.}}{13}\ \overset{\text{gr.}}{11}$ to grains.

(5) Reduce 5678545 drams to tons.

(6) A bar of gold weighs $\overset{\text{lbs.}}{31}\ \overset{\text{oz.}}{5}\ \overset{\text{dwts.}}{17}\ \overset{\text{gr.}}{13}$, what is the weight of 632 such bars ?

(7) How many men will $\overset{\text{a.}}{638}\ \overset{\text{r.}}{0}\ \overset{\text{p.}}{13}\ \overset{\text{yds.}}{1}$ of land supply, each having $\overset{\text{a.}}{3}\ \overset{\text{r.}}{2}\ \overset{\text{p.}}{13}\ \overset{\text{yds.}}{17}$?

(8) In 125 volumes there are $\overset{\text{reams}}{14485}\ \overset{\text{qr.}}{6}\ \overset{\text{sh.}}{5}$, how much paper does each volume contain ?

(9) Find the greatest common measure of 776, 3176, 4776.

(10) Find the least common multiple of 5, 15, 35, 75, 105, 125.

(11) Reduce 75½ miles per hour to feet per second.

(12) Reduce 39⅛ feet per second to miles per hour.

(13) A train moves at the rate of 36½ miles per hour, find its velocity.

PART THE SECOND.

FRACTIONS.

A fraction represents a part of a whole, and is expressed by two numbers, placed one above the other, as $\frac{4}{7}$, the upper figure is called the *numerator* and the lower the *denominator*.

The *denominator* shows, into how many parts the whole is divided, and the *numerator* shows how many of those parts are represented by the fraction. For instance, the 7 shows that the whole is divided into seven equal parts. and the 4 shows that four of those parts are taken ; this fraction is called four-sevenths.

A fraction admits of another interpretation of great importance. Thus $\frac{4}{7}$ means that four *wholes* are divided into seven equal parts.

A *proper fraction.* is one whose numerator is less than the denominator, as $\frac{5}{12}$ or $\frac{13}{18}$.

An *improper fraction*, is one whose numerator is greater than the denominator, as $\frac{5}{3}$ or $\frac{9}{5}$.

A *mixed number* is represented by a whole number and a fraction, as $5\frac{2}{7}$ or $4\frac{5}{8}$.

Change the following improper fractions to mixed numbers,

Section 1.

(1) $\frac{13}{4}$ (2) $\frac{18}{5}$ (3) $\frac{15}{4}$ (4) $\frac{121}{7}$ (5) $\frac{342}{12}$ (6) $\frac{321}{17}$ (7) $\frac{432}{18}$ (8) $\frac{836}{24}$ (9) $\frac{567}{152}$

Section 2.

(10) $\frac{345}{6}$ (11) $\frac{3146}{8}$ (12) $\frac{5167}{9}$ (13) $\frac{567}{19}$ (14) $\frac{8315}{153}$ (15) $\frac{51675}{321}$ (16) $\frac{8340}{1567}$

Section 3.

(17) $\frac{567}{5}$ (18) $\frac{1034}{7}$ (19) $\frac{5304}{9}$ (20) $\frac{863}{15}$ (21) $\frac{5067}{17}$ (22) $\frac{8037}{142}$ (23) $\frac{5671}{233}$

(24) $\frac{83670}{423}$

Section 4.

(25) $\frac{5671}{4}$ (26) $\frac{83146}{11}$ (27) $\frac{53145}{13}$ (28) $\frac{89367}{22}$ (29) $\frac{831467}{35}$ (30) $\frac{83675}{567}$

Section 5.

(31) $\frac{5678}{12}$ (32) $\frac{8346}{31}$ (33) $\frac{4067}{19}$ (34) $\frac{56789}{156}$ (35) $\frac{80967}{324}$ (36) $\frac{80306}{567}$

Section 6,

(37) $\frac{83409}{13}$ (38) $\frac{89504}{77}$ (39) $\frac{50767}{99}$ (40) $\frac{67043}{536}$ (41) $\frac{83467}{304}$ (42) $\frac{76843}{931}$

Section 7.

(43) $\frac{13467}{8}$ (44) $\frac{53046}{43}$ (45) $\frac{83046}{78}$ (46) $\frac{93467}{167}$ (47) $\frac{83046}{513}$
(48) $\frac{3141678}{1156}$.

Change the following mixed numbers to improper fractions,

Section 1.

(1) $5\frac{3}{4}$ (2) $8\frac{1}{3}$ (3) $9\frac{3}{5}$ (4) $7\frac{5}{12}$ (5) $8\frac{9}{13}$ (6) $7\frac{13}{15}$ (7) $9\frac{3}{21}$
(8) $11\frac{5}{17}$ (9) $12\frac{7}{15}$

Section 2.

(10) $13\frac{14}{17}$ (11) $5\frac{18}{25}$ (12) $8\frac{6}{48}$ (13) $19\frac{14}{17}$ (14) $24\frac{16}{29}$ (15) $18\frac{5}{37}$
(16) $27\frac{7}{77}$ (17) $32\frac{11}{104}$

Section 3.

(18) $15\frac{7}{13}$ (19) $22\frac{7}{8}$ (20) $34\frac{18}{47}$ (21) $131\frac{5}{9}$ (22) $136\frac{17}{19}$
(23) $232\frac{13}{17}$ (24) $104\frac{5}{18}$

Section 4.

(25) $31\frac{8}{23}$ (26) $81\frac{7}{15}$ (27) $189\frac{8}{12}$ (28) $319\frac{8}{13}$ (29) $506\frac{\text{[illegible]}}{11}$
(30) $8304\frac{9}{11}$ (31) $516\frac{14}{17}$

Section 5.

(32) $56\frac{7}{9}$ (33) $134\frac{11}{12}$ (34) $867\frac{13}{17}$ (35) $106\frac{7}{15}$ (36) $506\frac{14}{15}$

(37) $803\frac{17}{21}$ (38) $1326\frac{18}{121}$

Section 6.

(39) $104\frac{15}{23}$ (40) $117\frac{17}{27}$ (41) $136\frac{5}{104}$ (42) $834\frac{19}{105}$ (43) $4060\frac{18}{73}$

(44) $8610\frac{121}{182}$ (45) $4060\frac{83}{187}$

Section 7.

(46) $316\frac{7}{13}$ (47) $8130\frac{18}{29}$ (48) $516\frac{8}{133}$ (49) $8130\frac{87}{223}$

(50) $5060\frac{506}{678}$ (51) $8060\frac{31}{324}$

The following is a very important principle in fractions.

If the numerator and denominator of a fraction be each multiplied or each divided by the same number, the fraction is not altered in value.

Reduce the following fractions to their lowest terms.

Section 1.

(1) $\frac{39}{104}$ (2) $\frac{102}{119}$ (3) $\frac{209}{228}$ (4) $\frac{1573}{2057}$ (5) $\frac{4068}{5424}$ (6) $\frac{1424}{2492}$

(7) $\frac{15730}{28314}$ (8) $\frac{1216}{2736}$

Section 2.

(9) $\frac{138}{192}$ (10) $\frac{436}{327}$ (11) $\frac{4045}{3236}$ (12) $\frac{18624}{21728}$ (13) $\frac{35441}{45567}$

(14) $\frac{65871}{55737}$ (15) $\frac{6617}{9671}$

Section 3.

(16) $\frac{168}{392}$ (17) $\frac{7254}{4030}$ (18) $\frac{3454}{5338}$ (19) $\frac{5663}{15371}$ (20) $\frac{3192}{12236}$

(21) $\frac{4336}{8130}$ (22) $\frac{2721}{15419}$

Section 4.

(23) $\frac{6656}{7168}$ (24) $\frac{4256}{4788}$ (25) $\frac{79560}{84864}$ (26) $\frac{4152}{4498}$ (27) $\frac{4864}{4256}$

(28) $\frac{18144}{19845}$ (29) $\frac{8772}{10836}$

Section 5.

(30) $\frac{4560}{5776}$ (31) $\frac{10146}{12282}$ (32) $\frac{25355}{86207}$ (33) $\frac{5130}{5814}$ (34) $\frac{1548}{14448}$

(35) $\frac{10684}{144234}$ (36) $\frac{20668}{180845}$

ADDITION AND SUBTRACTION OF FRACTIONS.

In the addition and substraction of fractions, the two following principles cannot be too strongly impressed on the attention of the student.

1st. Before fractions can be added, or subtracted, their denominators must be made alike.

2nd. The denominators of fractions are made alike by multiplying the numerator and denominator by the same number.

Find the values of the following fractions.

Section 1.

(1) $\frac{8}{13} + \frac{1}{5}$ (2) $\frac{5}{7} + \frac{3}{9}$ (3) $\frac{4}{11} + 1$ (4) $2 + 3\frac{5}{6}$

(5) $\frac{3}{16} + \frac{4}{15}$ (6) $\frac{10}{12} + \frac{3}{13}$

Section 2.

(7) $\frac{3}{5} + \frac{1}{7}$ (8) $\frac{3}{7} + \frac{1}{9}$ (9) $\frac{5}{7} + \frac{3}{13}$ (10) $\frac{4}{9} + \frac{1}{13}$

(11) $\frac{8}{15} + \frac{3}{17}$ (12) $\frac{4}{15} + \frac{2}{19}$

Section 3.

(13) $\frac{3}{7} - \frac{1}{5}$ (14) $\frac{8}{13} - \frac{1}{6}$ (15) $\frac{9}{13} - \frac{1}{3}$ (16) $\frac{5}{7} - \frac{3}{15}$.

(17) $\frac{14}{15} - \frac{1}{11}$ (18) $\frac{3}{24} - \frac{5}{46}$

Section 4.

(19) $\frac{1}{35} - \frac{1}{45}$ (20) $\frac{3}{36} + \frac{5}{46}$ (21) $\frac{18}{28} - \frac{35}{96}$ (22) $\frac{4}{13} - \frac{7}{84}$

(23) $\frac{15}{27} - \frac{4}{9}$ (24) $\frac{16}{104} - \frac{3}{106}$

Section 5.

(25) $\frac{2\frac{1}{4}}{3} + \frac{3\frac{1}{5}}{7}$ (26) $\frac{4\frac{1}{2}}{3\frac{1}{3}} - \frac{2\frac{1}{3}}{4\frac{1}{2}}$ (27) $\frac{2\frac{1}{4}}{4} - \frac{\frac{1}{3}}{5}$ (28) $\frac{5\frac{1}{4}}{9} - \frac{\frac{1}{3}}{6}$

(29) $\frac{3\frac{1}{8}}{5} + \frac{5\frac{1}{15}}{7}$ (30) $\frac{8}{3\frac{1}{4}} - \frac{2\frac{1}{3}}{5\frac{1}{4}}$

Section 6.

(31) $\frac{8}{24} - \frac{3}{120}$ (32) $\frac{3}{7} - \frac{5}{84}$ (33) $\frac{7}{9} - \frac{4}{63}$ (34) $\frac{12}{13} + \frac{1}{65}$

(35) $\frac{9}{25} + \frac{2}{125}$ (36) $\frac{19}{84} - \frac{4}{252}$

Section 7.

(37) $\frac{3}{5} + \frac{1}{15} - \frac{1}{30} + \frac{1}{60}$ (38) $\frac{8\frac{1}{3}}{4\frac{1}{2}} + \frac{24}{9} - \frac{4}{3}$

(39) $\frac{3}{14} - \frac{1}{21} + \frac{1}{42}$ (40) $\frac{6}{8} - \frac{3}{24} + \frac{1}{56}$

(41) $\frac{5}{12} - \frac{1}{48} + \frac{1}{72} + \frac{1}{444}$ (42) $\frac{1}{8} - \frac{3}{24} + \frac{1}{32} + \frac{9}{40}$

Section 8.

(43) $\frac{3}{11} - \frac{2}{33} + \frac{1}{66} - \frac{5}{22} + \frac{1}{4}$ (44) $\frac{1}{5} + \frac{1}{15} - \frac{2}{45} - \frac{5}{18} + \frac{8}{36}$

(45) $\frac{8}{5} - \frac{3}{15} + \frac{7}{12} + \frac{1}{30} - \frac{1}{24}$ (46) $3\frac{1}{4} + 5\frac{1}{7}$

(47) $3\frac{1}{4} - 1\frac{1}{16}$ (48) $\frac{9}{14} + \frac{1}{28} - \frac{5}{42}$

Section 9.

(49) $2\frac{1}{4} + 3\frac{1}{12} - \frac{1}{3} + \frac{1}{5}$ (50) $\frac{5}{9} + \frac{1}{36} - \frac{3}{72} + \frac{5}{144} - \frac{7}{16}$

51) $\frac{4}{15} + \frac{1}{30} + \frac{2}{10} - \frac{1}{2} + 2\frac{1}{2} - 1\frac{1}{4}$

(52) $\frac{5}{6} + \frac{7}{12} - \frac{17}{24} - \frac{5}{12} + 3\frac{1}{2}$

(53) $\frac{5}{7} + \frac{3}{21} + \frac{5}{35} + \frac{6}{70}$ (54) $\frac{9}{81} + \frac{1}{9} + \frac{2}{3} + \frac{1}{27}$

Section 10.

(55) $\frac{3}{5} - \frac{13}{45} + \frac{7}{15}$ (56) $\frac{8}{13} - \frac{1}{39} + \frac{1}{5} - \frac{1}{25}$

(57) $\frac{8}{15} - \frac{1}{45} + \frac{1}{24} + \frac{1}{6}$ (58) $\frac{2}{5} - \frac{1}{15} + \frac{1}{10} - \frac{1}{30}$

(59) $\frac{5}{9} - \frac{1}{27} + \frac{1}{8} - \frac{1}{12}$ (60) $2\frac{1}{3} + 3\frac{1}{5} - 2\frac{1}{4}$

Section 11.

(61) $4\frac{1}{3} - 2\frac{3}{9} + 5\frac{1}{27}$ (62) $8\frac{3}{9} - 2\frac{1}{36} + 5\frac{1}{12}$

(63) $31\frac{31}{55} - 16\frac{5}{11} + 3\frac{1}{5} - 2\frac{1}{110}$

(64) $24\frac{5}{6} - 13\frac{1}{12} + 15\frac{1}{24} - 3\frac{1}{24}$

(65) $3\frac{1}{5} - 2\frac{1}{6} + 3\frac{1}{4} - 2\frac{1}{8} + 5\frac{1}{7} - 2\frac{1}{14}$

(66) $3\frac{1}{2}$ of $2\frac{1}{3} + 7\frac{1}{2}$ of $3\frac{1}{3}$

Section 12.

(67) $2\frac{1}{9}$ of $3\frac{1}{19} + 2\frac{1}{11}$ of $3\frac{1}{23}$ (68) $5\frac{9}{16}$ of $15 - 3\frac{1}{4}$ of $8\frac{3}{13}$

(69) $18\frac{3}{5}$ of $2\frac{1}{2} - 3\frac{1}{4}$ of $2\frac{1}{13}$ (70) $7\frac{1}{2} - 3\frac{1}{3} + 4\frac{1}{12} - 3\frac{1}{8}$

(71) $7\frac{1}{2}$ of $3\frac{1}{5} - 2\frac{1}{8}$ of $1\frac{1}{5}$ (72) $\frac{2}{8} + \frac{3}{16} + \frac{5}{4}$

Section 13.

(73) $\dfrac{2\frac{1}{2}}{3\frac{1}{4}} + \dfrac{3\frac{1}{4}}{5\frac{1}{8}} + 1$

(74) $\dfrac{2\frac{1}{5}}{6\frac{1}{15}} + \dfrac{3\frac{1}{8}}{5\frac{1}{6}} + 2$

(75) $\frac{11}{12} + \frac{12}{13} + \frac{1}{26}$

(76) $\dfrac{2\frac{1}{2}}{5\frac{1}{8}} + \dfrac{2\frac{1}{4}}{8\frac{1}{2}} + 1$

(77) $\frac{4}{7} + \frac{8}{5} - \frac{1}{14} + \frac{1}{15}$

(78) $2\frac{1}{5} - 6\frac{1}{10} + 3\frac{1}{25} + 4\frac{1}{30}$

Section 14.

(79) $5\frac{1}{9} - 4\frac{1}{36} + 2\frac{1}{6}$

(80) $\dfrac{3\frac{1}{2}}{4\frac{1}{4}} - \dfrac{4\frac{1}{2}}{6\frac{1}{4}} + \frac{1}{2}$

(81) $\dfrac{8\frac{1}{3}}{2\frac{1}{4}} - \dfrac{5\frac{1}{5}}{6\frac{1}{6}} - 2\frac{1}{5} \times 6\frac{2}{15}$

(82) $\dfrac{4\frac{1}{3}}{9\frac{1}{9}} - \dfrac{5\frac{1}{6}}{7\frac{1}{12}} + 2$

(83) $3\frac{2}{3} + \frac{4}{9} - \frac{11}{12}$

(84) $\frac{2}{8} + \frac{2}{16} + \frac{5}{4}$

Section 15.

(85) $\dfrac{2\frac{1}{2}}{3\frac{1}{4}} + \dfrac{3\frac{1}{4}}{5\frac{1}{8}} + 1$

(86) $\dfrac{2\frac{1}{5}}{6\frac{1}{15}} + \dfrac{3\frac{1}{8}}{5\frac{1}{6}} + 2$

(87) $\frac{11}{12} + \frac{12}{13} + \frac{1}{26}$

(88) $\dfrac{3\frac{1}{2}}{5\frac{1}{8}} + \dfrac{2\frac{1}{4}}{8\frac{1}{2}} + 1$

(89) $\dfrac{\frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \frac{1}{7}}{1 - \frac{1}{5} - \frac{1}{4} + \frac{1}{6}}$

(90) $\dfrac{\frac{2}{4} - \frac{3}{8} + \frac{1}{16}}{\frac{1}{3} + \frac{1}{8} + \frac{1}{5}}$

MULTIPLICATION AND DIVISION OF FRACTIONS.

Section 1.

(1) $\frac{3}{19} \times \frac{4}{5}$ (2) $\frac{7}{12} \times \frac{3}{5}$ (3) $\frac{4}{7} \times \frac{5}{16}$

(4) $\frac{9}{12} \times \frac{4}{18} \times \frac{6}{5}$ (5) $\frac{4}{7} \times \frac{14}{20} \times \frac{13}{26} \times \frac{1}{2}$

(6) $\frac{8}{9} \times \frac{27}{64} \times \frac{3}{16}$ (7) $\frac{9}{10} \times \frac{3}{15} \times \frac{20}{29}$ (8) $\frac{8}{14} \times \frac{28}{24} \times \frac{3}{5}$

(9) $\frac{13}{14} \times \frac{17}{39} \times \frac{102}{56}$ (10) $\frac{3}{8} \times \frac{40}{45} \times \frac{6}{14}$ (11) $\frac{9}{10} \times \frac{15}{27} \times \frac{3}{4}$

(12) $\frac{1}{2} \times \frac{1}{2} \times \frac{1}{3} \times \frac{1}{3}$

Section 2.

(13) $\frac{3}{5} \div \frac{6}{10}$ (14) $\frac{4}{5} \div \frac{8}{15}$ (15) $\frac{3}{7} \div \frac{8}{28}$ (16) $\frac{5}{9} \div \frac{25}{81}$

(17) $\frac{7}{12} \div \frac{3}{36}$ (18) $\frac{4}{9} \div \frac{12}{18}$ (19) $\frac{7}{114} \div \frac{5}{57}$ (20) $\frac{6}{7} \div \frac{1}{2}$

(21) $\frac{1}{2} \div \frac{1}{2}$ (22) $\frac{1}{8} \div \frac{3}{12}$ (23) $6 \div \frac{84}{13}$ (24) $13 \div \frac{26}{14}$

Section 3.

(25) $\dfrac{2\frac{1}{3}}{4\frac{1}{3}} \times \dfrac{5\frac{1}{6}}{3\frac{1}{2}}$ (26) $1\frac{1}{5} \div 2\frac{1}{25}$ (27) $8\frac{1}{4} \div 16\frac{1}{7}$

(28) $\frac{3}{4} \times \frac{4}{7} \div \frac{8}{14}$ (29) $(2\frac{1}{4} \div 3\frac{1}{4}) \times 4\frac{1}{2}$ (30) $7 \div \frac{3}{7} \times \frac{3}{5}$

Section 4.

(31) $\frac{8}{9} \div 2\frac{1}{4} \times \frac{3}{7}$ (32) $\frac{9}{10} \times \frac{30}{28} \div \frac{18}{56}$ (33) $\frac{31}{33} \div \frac{62}{99} \times \frac{8}{9}$

(34) $\frac{3}{4}$ of $\frac{4}{3}$ of $\frac{3}{5}$ (35) $2\frac{1}{2}$ of $3\frac{1}{3}$ of $1\frac{1}{2}$ (36) $\frac{5}{7}$ of $\frac{7}{10}$ of $5\frac{1}{2}$

Section 5.

(37) $\frac{1}{5} \times \frac{2}{3} \times \frac{3}{4} \times \frac{5}{6} \div \frac{8}{14}$ (38) $\frac{5}{6} \times \frac{3}{9} \times \frac{27}{28} \times \frac{32}{14} \div \frac{16}{7}$

(39) $\frac{8}{14} \times \frac{28}{16} \times \frac{32}{56} \div \frac{32}{168}$ (40) $\frac{15}{17} \times \frac{8}{4} \div \frac{9}{16} \times \frac{5}{30} \times \frac{3}{15}$

(41) $2\frac{1}{5} \times 3\frac{3}{6} \times 2\frac{1}{4} \times 3\frac{1}{3}$ (42) $\frac{3}{5}$ of $\frac{10}{9}$ of $\frac{35}{47}$ of $\frac{141}{70}$

Section 6.

(43) $\frac{3}{9} \div \frac{5}{12} + \frac{5}{7} \div \frac{10}{14}$

(44) $\frac{5}{14} \div \frac{15}{28} \times \frac{3}{2} - \frac{7}{11} \times \frac{22}{21}$

(45) $\frac{7}{15} \div \frac{28}{45} + \frac{18}{19} \div \frac{36}{76}$

(46) $\frac{8}{25} \div \frac{24}{125} \times \frac{18}{30} - \frac{9}{17} \div \frac{63}{68}$

(47) $\frac{37}{55} \div \frac{111}{275} + \frac{84}{93} \div \frac{588}{465} - \frac{3}{7}$

(48) $\left(\frac{3}{4} - \frac{1}{4} \right) \div \frac{5}{8} - \frac{2}{5}$

Section 7.

(49) $\dfrac{2\frac{1}{5} + 3\frac{1}{6}}{3\frac{1}{6} - 2\frac{1}{5}} \div \frac{1}{29}$

(50) $\dfrac{\frac{1}{4} + \frac{1}{5} + \frac{1}{6}}{\frac{1}{4} - \frac{1}{5} + \frac{1}{6}} \times \frac{1}{37} + \frac{1}{18}$

(51) $\dfrac{14\frac{1}{2} - 12\frac{1}{4}}{14\frac{1}{2} + 12\frac{1}{4}} \times 107$

(52) $\frac{5}{6} \times \dfrac{3\frac{1}{2}}{4} \times 2\frac{1}{2} \times \frac{48}{35} \times \frac{4}{15}$

(53) $\frac{3}{9}$ of $\frac{18}{27}$ of $\frac{34}{15}$ of 3 of $\frac{49}{17}$

(54) $\dfrac{3\frac{1}{2} + 6\frac{1}{2}}{3\frac{1}{2} + 2\frac{1}{4}} \div \dfrac{2\frac{1}{4}}{3\frac{1}{8}}$

Section 8.

(55) $\dfrac{5\frac{1}{2} - 2\frac{1}{6}}{1\frac{1}{4} - \frac{1}{8}} \times \dfrac{2\frac{1}{2}}{3\frac{1}{4}} \div \dfrac{2\frac{1}{2}}{3\frac{1}{4}}$

(56) $\dfrac{7\frac{3}{5} - 1\frac{1}{15}}{8\frac{1}{5} - 7\frac{3}{5}} \times \frac{9}{98} \div \dfrac{2\frac{1}{3}}{3\frac{1}{3}}$

(57) $\dfrac{18\frac{5}{16} - 17\frac{3}{8}}{3\frac{1}{5} - 2\frac{3}{6}} \times \frac{112}{30} - \dfrac{3\frac{1}{2}}{2\frac{1}{4}}$

(58) $\dfrac{\frac{1}{4} - \frac{1}{3} + \frac{1}{5} + \frac{1}{6}}{\frac{1}{4} + \frac{1}{3} - \frac{1}{5} + \frac{1}{6}} \div \dfrac{2\frac{1}{3}}{3\frac{1}{8}}$

(59) $\dfrac{2\frac{1}{4} + 3\frac{1}{2} - 1\frac{1}{3}}{3\frac{1}{6} - 1\frac{1}{4} + 2\frac{1}{12}}$

(60) $\dfrac{3\frac{1}{5} - \frac{1}{10} + 2\frac{1}{4} - 1\frac{1}{2} + 2}{6\frac{1}{12} - 5\frac{1}{24} + 3\frac{1}{4} - 2\frac{1}{6} + 1\frac{1}{3} - 1\frac{1}{8}}$

Section 9.

(61) $\dfrac{3\frac{1}{2} - 1\frac{1}{3}}{1 - \frac{1}{5}} \div \frac{26}{21} \times \frac{8}{9}$

(62) $\dfrac{\frac{5}{8} - \frac{1}{3} + \frac{1}{24}}{6\frac{1}{2} - 1\frac{1}{3} + 1\frac{1}{4}} \div \frac{8}{77} \div \frac{1}{24}$

Section 10.

$$(63)\ \frac{3\frac{1}{18} + 2\frac{1}{36} - 1\frac{1}{8} + 2\frac{1}{9} - 1\,\frac{1}{12} + 5\frac{1}{6}}{1\frac{1}{12} + 5\frac{1}{72} - 3\frac{1}{36} + 4\frac{1}{8} + 2\frac{1}{4} + 1\frac{1}{24}}$$

$$(64)\ \frac{1\frac{1}{30} + 2\frac{1}{60} - 2\frac{1}{12} + 3\frac{1}{5} - 4\frac{1}{15} + 6\frac{1}{10} - 3\frac{1}{20}}{5\frac{1}{12} - 4\frac{1}{10} + 3\frac{1}{30} - 1\frac{1}{60} - 1\frac{1}{24} + 2\frac{1}{15} + 3\frac{1}{6} - 1\frac{1}{4}}$$

Section 11.

$$(65)\ \frac{\frac{1}{2} + \frac{3}{4} - \frac{1}{5} + \frac{1}{6} - \frac{1}{7} + \frac{1}{8}}{1\frac{1}{2} + 1\frac{3}{4} - 1\frac{2}{5} + 2\frac{5}{6} - 3\frac{5}{7} + 2\frac{7}{8}}$$

$$(66)\ \frac{\frac{2}{3}\text{ of }1\frac{1}{2}}{1\frac{1}{3}\text{ of }2\frac{1}{4}} \times \frac{1\frac{1}{5}\text{ of }2\frac{1}{4}}{3\frac{1}{6}\text{ of }1\frac{1}{2}}$$

Section 12.

$$(67)\ \frac{1\frac{1}{3} + 2\frac{1}{4}}{5\frac{1}{2} - 3\frac{1}{5}} \text{ of } \frac{2\frac{1}{6} - 1\frac{1}{12}}{6\frac{1}{24} + 1\frac{1}{3}}$$

$$(68)\ \frac{3\frac{1}{2} - 1\frac{1}{4} + 1\frac{1}{3}}{6\frac{1}{3} + 4\frac{1}{5} - 8} \div \frac{1\frac{1}{2}\text{ of }2\frac{1}{3}}{2\frac{1}{4}\text{ of }1\frac{1}{3}}$$

Section 13.

$$(69)\ \frac{5\frac{1}{6}\text{ of }3\frac{1}{2}}{7\frac{1}{4}\text{ of }4\frac{1}{3}} \div \frac{6\frac{1}{7}\text{ of }5\frac{1}{6}}{7\frac{1}{2}\text{ of }3\frac{1}{4}}\text{ of }2\frac{1}{3}$$

$$(70)\ \frac{2\frac{1}{3} + 3\frac{1}{4} - 5\frac{1}{12}}{1\frac{1}{4} + 3\frac{1}{6} - 2\frac{1}{24}}$$

Section 14.

$$(71)\ \frac{3\frac{1}{5} - 2\frac{1}{15} + 1\frac{1}{30}}{1\frac{1}{5} - \frac{2}{15} + 2\frac{1}{60}} \times \frac{3\frac{1}{2}}{4\frac{1}{6}} \div \frac{13}{37}$$

$$(72)\ \frac{3\frac{1}{2}\text{ of }\frac{1}{4}}{5\frac{1}{4}\text{ of }\frac{1}{2}} - \frac{9\frac{1}{3}\text{ of }2\frac{1}{5}}{19\frac{4}{5}\text{ of }11\frac{1}{3}} - \frac{36}{153}$$

Section 15.

(73) $\dfrac{2\frac{1}{2}}{3\frac{1}{2}} - \dfrac{4\frac{1}{4}}{2\frac{1}{4}} + 5\frac{1}{8}$

(74) $\frac{3}{4} - \frac{2}{24} + 3\frac{1}{2} - 2\frac{1}{15} + 1$

Section 16.

(75) $\dfrac{3\frac{1}{2}}{2\frac{1}{5}} - 1\frac{1}{5} + 2\frac{1}{6} - 1\frac{1}{6}$

(76) $\frac{1}{4} + \frac{1}{5} + \frac{1}{6} + \frac{1}{7} + \frac{1}{8}$

Seetion 17.

(77) $\frac{1}{7} + \frac{1}{9} - \frac{1}{11}$

(78) Which is the greatest of $\frac{6}{7}$ $\frac{7}{8}$; $\frac{9}{10}$; and how much is the sum of the first and last greater than the middle one ?

(79) $\dfrac{7\frac{1}{2} - 3\frac{1}{4}}{5\frac{1}{6} - 3\frac{1}{12}} \times \dfrac{3\frac{1}{2}}{4\frac{1}{3}} \div \frac{7}{13}$

(80) $\dfrac{5\frac{1}{2} - 1\frac{1}{3}}{6\frac{1}{3} - 2\frac{1}{2}} \times \frac{23}{15} \div \dfrac{3\frac{1}{2}}{2\frac{1}{2}} \div \frac{5}{7}$

EXAMPLES ON DIFFERENT UNITS OF MEASURE.

EXAMPLES.

Section 1.

(1) Find the value of $\frac{9}{15}$ of £1.
(2) Find the value of $\frac{3}{16}$ of 15 shillings.
(3) Find the value of $\frac{8}{14}$ of 13*s* 4*d*.
(4) Find the value of $\frac{31}{64}$ of £2 13*s*. 4*d*.
(5) Find the value of $\frac{3}{5}$ of $\frac{2}{3}$ of $\frac{5}{7}$ of 15*s*.
(6) Find the value of $\frac{4}{9}$ of $\frac{9}{10}$ of $\frac{10}{11}$ of a guinea.

Section 2.

(7) What part of a pound is $\frac{3}{5}$ of a shilling ?
(8) What part of a pound is $\frac{4}{7}$ of a penny ?
(9) What part of a guinea is £$\frac{3}{8}$?
(10) What part of a guinea is £$\frac{6}{14}$?
(11) What part of 30 shillings is $\frac{5}{9}$ of a guinea ?
(12) What part of 35 shillings is $\frac{5}{12}$ of 24 shillings ?

Section 3.

(13) Find the value of $\frac{8}{34}$ of £100.

(14) Find the value of $\frac{7}{8}$ of $\frac{8}{9}$ of $\frac{9}{10}$ of $\frac{10}{12}$ of £100 19*s.* 9*d.*

(15) Find the value of $\frac{3}{12}$ of $\frac{4}{5}$ of $\frac{3}{7}$ of 18 shillings.

(16) Find the value of $2\frac{1}{2}$ of $3\frac{1}{2}$ of £5.

(17) Find the value of $\frac{2\frac{1}{2}}{3\frac{1}{4}}$ of $\frac{6\frac{1}{7}}{5\frac{1}{7}}$ of £1 3*s.* 6*d.*

(18) Find the value of $\frac{3}{7}$ of $1\frac{1}{2}$ of $\frac{7}{12}$ of 31*s.* 6*d.*

Section 4.

(19) What part of a pound is 3*s.* 6*d.* ?

(20) Reduce 8*s.* $7\frac{1}{2}$*d.* to the fraction of a pound.

(21) What part of a guinea is 15*s.* 6*d.* ?

(22) Reduce $7\frac{1}{2}$*d.* to the fraction of 25 shillings.

(23) What part of 18s. is $\frac{4}{7}$ of a guinea ?

(24) Reduce $\frac{5}{18}$ of a crown to the fraction of 10s.

Section 5.

(25) Find the value of $\frac{3}{5}$ of a ton.

(26) Find the value of $\frac{9}{13}$ of $\frac{3}{8}$ of $\frac{4}{15}$ of 1 cwt.

(27) Find the value of $\frac{35}{75}$ of $\frac{75}{76}$ of 1 ton 17 cwt. 15 lbs.

(28) Find the value of 3 $\frac{3}{9}$ tons.

(29) Find the value of £6 $\frac{15}{19}$.

(30) Find the value of 3 $\frac{3}{11}$ cwt.

Section 6.

(31) What part of a ton is $6\frac{1}{2}$ lbs. ?

(32) Reduce $\frac{3}{15}$ of a cwt. to the fraction of a ton.

(33) What part of a cwt. is $\frac{8}{10}$ of a lb. ?

(34) Reduce $\frac{2016}{8}$ of an oz. to the fraction of a cwt.

(35) What part of a ton is 4 cwt. 3 qr. 5 lbs. 6 oz. ?

(36) Reduce 3 qr. 12 lbs. 15 oz. to the fraction of a cwt.

Section 7.

(37) Find the value of $8\frac{11}{16}$ miles.

(38) Find the value of $17\frac{13}{115}$ furlongs.

(39) Find the value of $\frac{3}{7}$ of $\frac{8}{9}$ of $\frac{3}{8}$ of 8 m. 6 f. 113 yds.

(40) Find the value of $8\frac{1}{13}$ yds. + $3\frac{1}{8}$ — $4\frac{1}{7}$ inches.

Section 8.

(41) Find the value of $\overset{\text{m.}}{9\frac{3}{15}} + \overset{\text{f.}}{4\frac{3}{5}} - \overset{\text{yds.}}{2\frac{1}{3}}$

(42) Find the value of $\overset{\text{yds.}}{17\frac{1}{3}} + \overset{\text{ft.}}{3\frac{1}{15}} + \overset{\text{in.}}{4}$.

(43) What part of a pound is 8 shilings ?

(44) What part of a pound is 7 shillings ?

Section 9.

(45) What part of a mile is $\frac{3}{8}$ of a furlong ?

(46) Reduce $\frac{8}{15}$ of a yard to the fraction of a furlong.

(47) What part of $12\frac{1}{2}$ miles is $18\frac{3}{4}$ furlongs ?

(48) Reduce 1100 yards to the fraction of $2\frac{1}{7}$ furlongs.

(49) What part of $8\frac{1}{7}$ yards is $2\frac{1}{3}$ feet ?

(50) Reduce $3\frac{1}{7}$ in. to the fraction of $6\frac{1}{3}$ feet.

Section 10.

(51) Find the value of $\frac{7}{15}$ of an acre.

(52) Find the value of $\frac{13}{25}$ of 2 a. 1 r.

(53) Find the value of $\frac{3}{12}$ of $\frac{4}{18}$ of 4 acres.

(54) Find the value of $7\frac{1}{15}$ acres.

Section 11.

(55) Find the value of $\overset{\text{a.}}{2\frac{1}{9}} + \overset{\text{r,}}{2\frac{1}{3}} - \overset{\text{p.}}{5\frac{3}{8}}$

(56) Find the value of $\overset{\text{r.}}{1\frac{17}{18}} + \overset{\text{p.}}{3\frac{3}{8}} - \overset{\text{p.}}{29\frac{1}{3}}$.

Section 12.

(57) What part of an acre is $5\frac{3}{7}$ poles ?

(58) Reduce 16 perches to the fraction of 3 roods.

(59) What part of $18\frac{5}{8}$ p· is $28\frac{1}{4}$ yards ?

(60) Reduce $105\frac{1}{3}$ p. to the fraction of $20\frac{3}{16}$ acres.

(61) What part of an acre is $3\frac{3}{4}$ perches ?

(62) Reduce *7d.* to the fraction of a guinea.

Section 13.

(63) Find the value of $\frac{23}{35}$ of a cubic yard.

(64) Find the value of $\frac{2}{4}$ of $\frac{8}{9}$ of $\frac{8}{16}$ of $3\frac{1}{2}$ cubic yards.

(65) Find the value of $\frac{3}{4}$ of $\frac{5}{6}$ of $1\frac{1}{2}$ cubic feet $+ \frac{3}{8}$ ft.

(66) Find the value of $\frac{3}{4}$ of $\frac{2\frac{1}{4}}{3\frac{1}{4}}$ of 3 cubic yards.

Section 14.

(67) Find the value of $\frac{3}{5}$ of $\frac{1}{12}$ of 1 ft. + $\frac{2\frac{1}{3}}{3\frac{1}{3}}$ of 1 cubic yard.
(68) Find the value of $2\frac{1}{3}$ cubic yards + $3\frac{1}{4}$ cubic feet.

Section 15.

(69) What part of a cubic yard is $4\frac{1}{2}$ cubic feet ?
(70) Reduce $2\frac{1}{2}$ cubic feet to the fraction of $2\frac{1}{2}$ cubic yards.
(71) What part of $\frac{19}{36}$ cubic feet is $6\frac{1}{3}$ cubic inches ?
(72) Reduce $4\frac{1}{3}$ m. to the fraction of $\frac{7}{48}$ cubic feet.
(73) What part of $1\frac{8}{27}$ cubic yards is $8\frac{3}{4}$ cubic feet ?
(74) Reduce $87\frac{15}{19}$ cubic m. to the fraction of $\frac{139}{228}$ cubic yds.

Section 16.—(Troy Weight.)

(75) Find the value of $\frac{94}{124}$ of $1\frac{1}{3}$ of a pound.
(76) Find the value of $\frac{4}{9}$ of $\frac{3}{8}$ of 3 lbs. + $4\frac{5}{8}$ ozs.
(77) Find the value of $3\frac{1}{4}$ lbs. + $5\frac{3}{5}$ oz. + $6\frac{5}{16}$ dwts. — 15 g
(78) Find the value of $5\frac{1}{8}$ lbs. + $\frac{3\frac{1}{2} - 2\frac{1}{4}}{4\frac{1}{2} - 1\frac{1}{4}}$ of 2 ounces.

Section 17.

(79) Find the value of $\frac{5\frac{1}{6} - 2\frac{1}{9}}{3\frac{1}{6} - 2\frac{1}{9}}$ of 1 lb. + $\frac{2\frac{1}{2}}{3\frac{1}{8}}$ of 2 lbs.

(80) Find the value of $\frac{2\frac{1}{4} + 3\frac{1}{8}}{3\frac{1}{8} - 2\frac{1}{4}}$ of 3 oz. + $\frac{3\frac{1}{8} - 2\frac{1}{16}}{5\frac{1}{12} - 1\frac{1}{24}}$ of 3 lbs.

Section 18.—(Troy Weight.)

(81) What part of a pound is $3\frac{1}{3}$ dwts. ?
(82) Reduce $8\frac{1}{3}$ grains to the fraction of $\frac{41}{15}$ oz.
(83) What part of $1\frac{1}{2}$ pound is 4 $\frac{1}{3}$ oz. ?
(84) Reduce $18\frac{3}{4}$ dwts. to the fraction of $1\frac{1}{4}$ lb.

Section 19.

(85) What part of $\frac{23}{144}$ lb. is $8\frac{2}{3}$ grains ?
(86) Reduce $7\frac{5}{12}$ dwts. to the fraction of $\frac{89}{144}$ lb.
(87) What part of a pound is 1 oz. 1 dwt. $19\frac{7}{11}$ grs. ?
(88) Reduce 1 oz. 17 dwts. $21\frac{9}{10}$ grs. to the fraction of a pound

Section 20.

(89) Find the value of $6\frac{1}{3}$ years.
(90) Find the value of $3\frac{1}{5}$ years + $2\frac{1}{3}$ years.
(91) Find the value of $4\frac{8}{15}$ days + $2\frac{5}{23}$ days.
(92) Find the value of $\frac{2}{3}$ of $\frac{2}{5}$ of $\frac{8}{9}$ of $\frac{1}{12}$ of 3 years.

Section 21.

(93) Find the value of $2\frac{144}{175}$ months — $1\frac{5}{9}$ weeks + $5\frac{15}{125}$ days.
(94) Find the value of $5\frac{1}{4}$ years + $3\frac{1}{5}$ months.

Section 22.

(95) What part of a year is $7\frac{1}{2}$ weeks ?
(96) Reduce $19\frac{1}{3}$ weeks to the fraction of 29 years.
(99) What part of 17 months is $2\frac{5}{6}$ weeks ?
(100) What part of 31 weeks is $3\frac{4}{9}$ days ?
(101) Reduce 3 wks. 3 dys. 6 hrs. 24 m. to the fraction of 1 year.
(102) What part of $3\frac{1}{2}$ years is 8 weeks 4 days 16 hours ?

Section 23.

(103) Find the value of $\frac{5}{9}$ lbs. troy + $\frac{6}{7}$ lbs. avoir.
(104) Find the value of $\frac{2}{3}$ tons — $3\frac{1}{5}$ cwts. + $4\frac{3}{5}$ lbs.
(105) Find the value of $3\frac{1}{3}$ lbs. troy — $1\frac{5}{18}$ lbs. avoir.
(106) Find the value of $\frac{3}{5}$ mile — $2\frac{1}{5}$ furlongs.

Section 24.

(107) What part of a load is $2\frac{1}{3}$ gallons ?
(108) Reduce $5\frac{1}{8}$ bushels to the fraction of $3\frac{7}{8}$ loads.
(109) Reduce $1\frac{3}{4}$ pecks to the fraction of $3\frac{1}{2}$ quarts.
(110) Reduce $6\frac{1}{3}$ pecks to the fraction of $1\frac{17}{32}$ quarts.
(111) What part of $3\frac{1}{4}$ loads is 1 qr. 0 b. 0 p. 1 q. ?
(112) Reduce 3 qr. 0 b. 1 p. $1\frac{4}{5}$ qr. to the fraction of $5\frac{1}{2}$ loads.

Section 25.

(113) Find the value of $\dfrac{8\frac{1}{3} - 5\frac{1}{3}}{2\frac{1}{2} - 1\frac{1}{3}}$ of $\dfrac{6\frac{1}{2}}{4\frac{1}{6}}$ of 17*l.* 6*s.* 8*d.*

(114) Find the value of $\dfrac{5\frac{1}{2} + 6\frac{1}{3}}{8\frac{1}{2} - 4\frac{1}{3}}$ of $\dfrac{\frac{2}{3}}{\frac{5}{6}}$ of 18*s.* 9*d.*

Section 26.

(115) Find the value of $\frac{3}{\frac{5}{8}}$ of $\frac{\frac{4}{3}}{7}$ of 3 tons.

(116) Find the value of $\frac{5}{9} \div \frac{3\frac{1}{5} - 2\frac{1}{5}}{3\frac{1}{5} + 2\frac{1}{5}}$ of 5 $\frac{1}{8}$ tons.

Section 27.

(117) What part of £1 is 3*s.* 9*d.* 3$\frac{4}{9}$*f.* ?

(118) Reduce 1 yard 1 foot 6 ins. to the fraction of 5¼ yards.

Section 28.

(119) What part of 3½ guineas is 3*s.* 4¾*d.* ?

(120) Reduce 12*s.* 4*d.* 3$\frac{7}{11}$*f.* to the fraction of 3¼ guineas.

Section 29.

(121) Find the value of $\frac{5\frac{1}{6} - 3\frac{1}{3}}{3\frac{1}{2} - 2\frac{1}{6}}$ of $\frac{\frac{3}{4}}{\frac{5}{8}}$ of 3 miles.

(122) Find the value of $\frac{5}{9}$ of $\frac{9}{10}$ of $\frac{10}{11}$ of 3 m. 5 f.

Section 30.

(123) What part of £3⅕ is 17*s.* 5$\frac{145}{455}$*d.* ?

(124) Reduce 1*l.* 7*s.* 1*d.* to the fraction of £2⅙.

(125) What part of a guinea is 14*s.* ?

(126) What part of £1 is 2*s.* 6*d.* ?

Section 31.

(127) Find the value of $\frac{7}{9}$ of $\frac{9}{14}$ of $\frac{3}{15}$ of 3*l.* 4*s.* 6*d.* ?

(128) Find the value of £⅔ + ¾ of 5*s.* — 8½*d.*

(129) What part of £1 is 8*d.* ?

(130) Reduce 6*d.* to the fraction of a guinea.

(131) What part of 10*s.* is 3*s.* 4*d.* ?

(132) Reduce ¾*d.* to the fraction of a shilling.

Section 32.

(133) Find the value of $\frac{2\frac{1}{2} + 3\frac{1}{3}}{3\frac{1}{3} - 2\frac{1}{2}}$ of $\frac{3\frac{1}{2}}{4\frac{1}{5}}$ of 15s.

(134) Find the value of $\frac{3\frac{1}{4} - 2\frac{1}{6}}{3\frac{1}{4} + 2\frac{1}{6}}$ of $\frac{3\frac{1}{2}}{2\frac{1}{6}}$ of 1 acre 2 roods.

(135) What part of 17*s.* is 8½*d.* ?

(136) What part of 3*l.* 12*s.* is 9*s.* ?

(137) Reduce 2⅜ feet to the fraction of a furlong.

Section 33.

(138) Find the value of $\frac{5\frac{1}{2}}{3\frac{1}{4}}$ of $\frac{6\frac{1}{2}}{2\frac{1}{3}}$ of 2 acres.

(139) Find the value of $\left\{(\frac{1}{4}+\frac{1}{3})-(\frac{1}{3}-\frac{1}{4})\right\}$ of 5 a. 3 r. 26 p.

(140) What part of a yard is $2\frac{3}{8}$ inches ?

(141) What part of $2\frac{1}{3}$ yards is $7\frac{1}{3}$ inches ?

Section 34.

(142) Find the value of $(\frac{1}{4}+\frac{1}{6}+\frac{1}{8})$ of a cubic yard.

(143) Find the value of $(\frac{3}{5}-\frac{1}{25}+\frac{1}{35})$ of $\frac{35}{48}$ of 3 cubic yards.

Section 35.

(144) Find the value of $(\frac{1}{4}-\frac{1}{5})(\frac{1}{5}-\frac{1}{6})$ of 3 lbs.

(145) Find the value of $\frac{2\frac{1}{8}+3\frac{1}{3}}{3\frac{1}{8}-2\frac{1}{8}} \div \frac{2\frac{1}{2}}{4\frac{1}{5}}$ of $6\frac{1}{2}$ lbs.

Section 36.

(146) Find the value of $\frac{8\frac{1}{2}-6\frac{1}{4}}{2\frac{1}{2}-1} \times \frac{3\frac{1}{8}}{2}$ of 1 year.

(147) Find the value of $(\frac{1}{4}+\frac{1}{3})(\frac{1}{5}+\frac{1}{6})$ of a month.

Section 37.

(148) Find the value of $\left(\frac{\frac{1}{4}-\frac{1}{5}+\frac{1}{6}}{\frac{1}{4}+\frac{1}{5}-\frac{1}{6}}+2\right)$ of $\frac{2\frac{1}{2}}{3\frac{1}{2}}$ of 15*s*.

(149) Find the value of $\frac{\frac{1}{4}-\frac{1}{5}}{\frac{1}{5}-\frac{1}{6}} \times \frac{\frac{1}{7}}{\frac{1}{14}} + \frac{3\frac{1}{2}}{8\frac{1}{2}}$ of a guinea.

Section 38.

(150) What part of a foot is $4\frac{1}{8}$ inches ?

(151) What part of a yard is $2\frac{3}{4}$ feet ?

(152) What part of $3\frac{1}{3}$ yards is 1 foot 4 inches ?

(153) Reduce $3\frac{5}{7}$ inches to the fraction of $2\frac{1}{7}$ yards.

(154) Find the value of $\frac{4}{7}$ of $\frac{7}{8}$ of $\frac{3}{5}$ of $2\frac{1}{2}$ guineas.

(155) Reduce 15*s*. $6\frac{1}{2}$*d*. to the fraction of a guinea and a half.

(156) Find the value of $\frac{5}{6}$ of $\frac{8}{16}$ of $\frac{10}{13}$ of $3\frac{1}{4}$ tons.

DECIMAL FRACTIONS,

A *decimal fraction* is a fraction whose denominator is either 10, 100, 1000, 10000, &c.

The *denominator* of a decimal fraction is cancelled, and a full stop placed before the numerator to distinguish it from a whole number, thus, $\frac{34}{100}$, $\frac{456}{1000}$ are written .34 ; .456.

Change the following Vulgar Fractions into Decimals.

Section 1.

(1) $\frac{3}{8}$ (2) $\frac{4}{15}$ (3) $19\frac{1}{4}$ (4) $2\frac{1}{5}$ (5) $15\frac{1}{8}$ (6) $17\frac{3}{19}$

(7) $\frac{5}{14}$ (8) $\frac{7}{15}$ (9) $1\frac{1}{6}$ (10) $\frac{2\frac{1}{2}}{3\frac{1}{5}}$ (11) $\frac{4\frac{1}{6}}{2\frac{1}{3}}$ (12) $\frac{3}{\frac{1}{5}} \cdot \frac{1}{17}$

Section 2.

(13) $18\frac{3}{4}$ (14) $124\frac{13}{15}$ (15) $104\frac{5}{88}$ (16) $98\frac{5}{7}$ (17) $33\frac{5}{16}$
(18) $22\frac{11}{32}$.

Change the following Decimal Fractions into Vulgar Fractions.

(19) ·145 (20) ·145 (21) 6·125 (22) 9·415 (23) 10·156
(24) 12·725 (25) ·15 (26) 1·75 (27) 3·85
(28) 1·725 (29) ·006 (30) ·0012.

Change the following Vulgar Fractions into Decimals.

Section 4.

(31) $\frac{\frac{3}{4}}{\frac{5}{8}}$ (32) $\frac{2\frac{1}{6}}{13\frac{1}{4}}$ (33) $\frac{5\frac{1}{3}}{\frac{1}{5}}$ (34) $\frac{13\frac{1}{4}}{4\frac{1}{6}}$ (3 $\frac{3 + 2\frac{1}{2}}{1\frac{1}{2} - \frac{1}{3}}$

(36) $\frac{4\frac{1}{6} - 1\frac{1}{3}}{4\frac{1}{6} + 1\frac{1}{3}}$.

Section 5.

(37) $\frac{\frac{5}{7}}{\frac{3}{17}}$ (38) $\frac{\frac{1}{4} + \frac{1}{3}}{\frac{1}{3} - \frac{1}{4}} \times \frac{2\frac{1}{2}}{1\frac{1}{3}}$ (39) $\frac{\frac{1}{3} + \frac{1}{6}}{1 - \frac{5}{6}} \times \frac{2\frac{1}{2}}{3\frac{1}{3}}$

(40) $\frac{\frac{2\frac{1}{2}}{3\frac{1}{2}}}{\frac{4\frac{1}{2}}{2\frac{1}{2}}}$ (41) $\frac{\frac{1}{4} - \frac{1}{16}}{1 - \frac{1}{6}} \times \frac{3}{4} + \frac{27}{16}$.

Section 6.

(42) $\frac{5\frac{1}{2}}{3\frac{1}{3}}$ (43) $\frac{5\frac{1}{6} - 2\frac{1}{12}}{3\frac{1}{12} - 1\frac{1}{6}} \times \frac{3\frac{1}{2}}{4\frac{1}{2}}$ (44) $\frac{5}{7} \div \frac{3}{7} - 1\frac{1}{4}$

(45) $(\frac{5}{8} - \frac{1}{3}) \div \frac{5}{9} \times \frac{2\frac{1}{2}}{3\frac{1}{3}}$.

ADDITION AND SUBTRACTION OF DECIMALS.

Section 1.

(1) Add together 3·145, 2·046, ·1567, 45·604, and ·0054.
(2) From 4·4567 take ·0059678.
(3) Add together 4·6789, ·043567, 9·04, and 345·06.
(4) From 134·04 take 39·05678.
(5) Add together 2·6785, 39·0467, ·00046, and 11·11057.
(6) From 894· take 72·0567.

Section 2.

Find the value of

(7) ·0467 + 59·678 — 2·345 — 1·00467 + 2·3067.
(8) ·5067 — ·00597 — ·34567 + 5·6789 — 2·59684.
(9) 164 + ·64 — 26·345 — ·0467 + 2·599 — 3·67894.

Section 3.

Find the value of

(10) 3·666 — 2·467 — ·2467 + ·02467 —·002467
(11) 594·46 — ·99446 + 3·456 — 1·654 + ·00567
(12) 67·412 — 2·378 + ·2367 — ·0359 + ·9467

MULTIPLICATION AND DIVISION OF DECIMALS.

Section 1.

Multiply	Multiply
(1) 32·47 by 22·26	(2) 104·324 by 104·32
(3) 33·405 by ·045	(4) 18·1416 by ·0033
(5) 15·1614 by 34·56	(6) 19·1415 by ·506

Section 2.

	Divide		Divide
(7)	·0099 by ·22	(8)	·4704 by 84
(9)	·018512 by 52	(10)	.00206752 by 1·42
(11)	1779·56 by 34	(12)	·022494 by ·652

Section 3.

	Divide		Divide
(13)	59·13637 by 1041·5	(14)	331·8175 by 14·15
(15)	·0182007 by ·0321	(16)	·7609444 by ·1532
(17)	1328·8122 by 3·1414	(18)	1·0226816 by ·0436

Section 4.

	Divide		Divide
(19)	·203840148 by ·03426	(20)	·012474 by 2·2
(21)	3·14 by ·05	(22)	1·467 by ·345
(23)	·01345 by ·000398	(24)	8 by ·0016

Section 5.

	Divide		Divide
(25)	28 by ·00007	(26)	36 by ·00012
(27)	112 by ·0000336	(28)	·54 by 125·42
(29)	1·32 by 83·45	(30)	·0047 by ·000067

Section 6.

	Divide		Divide
(31)	·356 by ·0054	(32)	·080578852 by ·02342
(33)	·0013197415 by ·03245	(34)	·0137935 by 245

(35) Find the value of $\frac{\cdot 03335}{.23} + \frac{5}{16} - \frac{\cdot 0798}{\cdot 42}$

36 Find the value of $\frac{19\cdot 6578}{\cdot 1467} - \frac{\cdot 02211}{\cdot 00067} - \frac{\cdot 068}{\cdot 002}$

Section 7.

(37) Find the value of $\frac{\cdot 015525}{\cdot 345} + \frac{\cdot 14592}{\cdot 032} - \frac{\cdot 0000136}{\cdot 0034}$

(38) Find the value of $\frac{\cdot 00053352}{\cdot 0342} - \frac{\cdot 01888}{\cdot 32} + \frac{\cdot 20412}{\cdot 36}$

(39) Find the value of $\frac{1\cdot 0584}{\cdot 189} - \frac{\cdot 072558}{\cdot 834} - \frac{\cdot 050901}{\cdot 057}$

Section 8.

(40) Find the value of $\frac{\cdot 22498}{\cdot 007} - \frac{\cdot 193052}{\cdot 034} - \frac{\cdot 02416736}{43\cdot 156}$

(41) Find the value of $\frac{\cdot 016821}{\cdot 003} - \frac{\cdot 34545}{9\cdot 87} - \frac{\cdot 000003108}{\cdot 0074}$

(42) Find the value of $\frac{\cdot 015525}{\cdot 345} + \frac{\cdot 14592}{\cdot 032} - \frac{\cdot 0000136}{\cdot 0034}$

Section 9.

(43) Find the value of $\frac{\cdot 32223}{\cdot 934} + \frac{\cdot 97236}{\cdot 18} - \frac{\cdot 002537}{\cdot 059}$

(44) Find the value of $\frac{.025272}{\cdot 324} - \frac{\cdot 31104}{34\cdot 56} - \frac{\cdot 005593768}{8\cdot 3504}$

Section 10.

(45) Find the value of $\frac{2\cdot 5488}{\cdot 59} - \frac{\cdot 25551}{5\cdot 678} - \frac{13\cdot 0884}{8\cdot 39}$

(46) Find the value of $\frac{\cdot 057979}{\cdot 037} - \frac{\cdot 66129}{9\cdot 87} - \frac{\cdot 578651}{13\cdot 457}$

(47) Find the value of $\frac{1\cdot 10088}{\cdot 834} - \frac{\cdot 05292}{\cdot 945} - \frac{\cdot 55878}{83\cdot 4} - \frac{\cdot 3616704}{8\cdot 372}$

EXAMPLES ON DIFFERENT UNITS OF MEASURE IN DECIMALS.

Section 1.

(1) Find the value of £·645.
(2) Find the value of £·8456.
(3) Find the value of £1·549.
(4) Find the value of £8·5436.
(5) Find the value of 3·456 guineas.
(6) Find the value of 4·678 crowns.
(7) Find the value of ·3456 half crowns.

Section 2.

(8) Find the value of ¾ of 1·345 £.
(9) Find the value of ⅞ of 2·125 £.
(10) Find the value of ⅝ of 3.125 guineas.
(11) Find the value of $\frac{9}{11}$ of 4·267 crowns.
(12) Find the value of $\frac{4}{7}$ of 8·196 half-crowns.
(13) Find the value of ¾ of 9·125 guineas.

Section 3.

(14) Reduce 5*s*. 3*d*. to the decimal of a pound.
(15) Reduce 5*s*. 9*d*. to the decimal of a guinea.
(16) Reduce 14s. 7½d. to the decimal of 24*s*.
(17) Reduce 13s. 4¼d. to the decimal of a pound.
(18) Reduce 6s. 7½d. to the decimal of 10s.
(19) Reduce £1 4*s*. 5¾*d*. to the decimal of a pound.
(20) Reduce £3 5*s*. 9¼*d*. to the decimal of a guinea
(21) Reduce ⅝ of 3*s*. 4*d*. to the decimal of a pound.

Section 4,

(22) Reduce ⅛ of a pound to the decimal of a guinea.
(23) Reduce ⅜ of a pound to the decimal of £1 4*s*.
(24) Reduce £4 7*s*. 8¾*d*. to the decimal of a pound.
(25) Reduce 9¾*d*. to the decimal of a shilling and a £.
(26) Reduce 4¾*d*. to the decimal of 3*s*. 4¼*d*.
(27) Reduce 1*s*. 6¾*d*. to the decimal of £3 4*s*. 7½*d*.
(28) Reduce £4 7*s*. 8½*d*. to the decimal of £5.

Section 5.

(29) Find the value of ·384 tons.
(30) Find the value of 1·456 tons.
(31) Find the value of ·156 cwt.
(32) Find the value of 1·678 of 3 tons.
(33) Find the value of 5·64 of half cwt.
(34) Find the value of 1·136 of 32 lbs.
(35) Find the value of 5·7684 lbs.

Section 6.

(36) Reduce 16 cwt. to the decimal of a ton.
(37) Reduce 16 cwt. 86 lbs. to the decimal of a ton.
(38) Reduce 1 t. 5 cwt. 3 q. 20 lb. 12 oz. 8 d. to the decimal of a ton.
(39) Reduce 3 lbs. 12 oz. 8½ dr. to the decimal of a cwt.
(40) Reduce 5 lbs. 10 oz. 4¾ dr. to the decimal of a lb.

Section 7.

(41) Find the value of 1·345 miles.
(42) Find the value of 5·645 yards.
(43) Find the value of ⅗ of 1·456 feet.
(44) Find the value of 2·146 of 24 feet.
(45) Find the value of 12·675 furlongs.
(46) Find the value of 7·845 feet.

Section 8.

(47) Reduce 6½ furlongs to the decimal of a mile.
(48) Reduce 1 mile 5 fur. 100 yards to the decimal of a mile.
(49) Reduce 5 yards 2 ft. 11 inches to the decimal of a yard.
(50) Reduce 2 ft. 6¼ in. to the decimal of a foot and yard.
(51) Reduce 1 mile 0 fur. 56 yds. 2 ft. 10 in. to the decimal of a mile.
(52) Reduce 3 yd. 1 ft. 6⅓ in. to the decimal of 4 yd. 2 ft. 4 in.

Section 9.

(53) Find the value of ·3456 acres.
(54) Find the value of 1·456 acres.
(55) Find the value of 4·345 acres.
(56) Find the value of ⅜ of 1·456 roods.
(57) Find the value of ⅘ of 1·046 acres.
(58) Find the value of ·01467 acres.

Section 10.

(59) Reduce 5⅓ poles to the decimal of an acre.
(60) Reduce 8 poles 15 yards to the decimal of an acre.
(61) Reduce 5 acres 2 roods 35 poles 15 yards to the decimal of an acre.
(62) Reduce 6⅔ poles to the decimal of a rood.
(63) Reduce 3 acres 2½ roods to the decimal of 3 acres.
(64) Reduce 5 acres 1 rood 26 poles to the decimal of 5 acres 2 roods.

Section 11.

(65) Find the value of 6·145 cubic yards.
(66) Find the value of 3·104 cubic yards.
(67) Find the value of 1·046 of 3⅓ cubic yards.
(68) Find the value of 2½ of 3·189 cubic feet.
(69) Find the value of ·064585 cubic yards.
(70) Find the value of ¾ of ·056785 cubic feet.

Section 12.

(71) Reduce $3\frac{1}{4}$ feet to the decimal of a cubic yard.
(72) Reduce 1 foot 36 inches to the decimal of a cubic yard.
(73) Reduce 1 yard 8 feet 50 in. to the decimal of a cubic yard.
(74) Reduce 3 yd. 7 ft. 54 in. to the decimal of 3 yd. 4 ft.
(75) Reduce 4 yd. 7 ft. 8 in. to the decimal of $3\frac{1}{2}$ yds.
(76) Reduce 3 feet 132 inches to the decimal of 4·27 yards.

Section 13.—(Troy Weight.)

(77) Reduce 16 dwts. to the decimal of 1 oz.
(78) Reduce $16\frac{1}{4}$ dwts. to the decimal of 1 lb.
(79) Reduce $20\frac{1}{4}$ grs. to the decimal of $10\frac{1}{8}$ lbs.
(80) Reduce 2 lbs. 4 oz. to the decimal of $4\frac{1}{8}$ lbs.
(81) Reduce 1 lb. 3 oz. 4 dwts. $14\frac{10}{18}$ grs. to the decimal of $5\frac{1}{2}$ lbs.
(82) Reduce 1 lb. 4 oz. 7dwts. $6\frac{6}{11}$ grs. to the decimal of $3\frac{3}{4}$ lbs.

Section 14.

(83) Find the value of ·346 lbs.
(84) Find the value of 1·678 lbs.
(85) Find the value of $\frac{1}{8}$ (3·146) lbs.
(86) Find the value of 1·567 of $2\frac{1}{2}$ oz.

(87) Find the value of $\frac{4·673}{1·04}$ of $1\frac{1}{4}$ lbs.

(88) Find the value of $\frac{·146}{·0056}$ of $3\frac{1}{5}$ oz.

(89) Find the value of $\frac{3}{5}$ of 1·67 lbs. + $\frac{4}{25}$ of ·678 oz. + $\frac{5}{6}$ of 1·3 dwt.

Section 15.

(90) Reduce 3 weeks 4 days to the decimal of a year.
(91) Reduce $4\frac{1}{3}$ weeks to the decimal of $2\frac{1}{3}$ years.
(92) Reduce 4 days 20 hours 2 minutes to the decimal of a month.
(93) Reduce 2 h. 13 m. 14 secs. to the decimal of $3\frac{1}{4}$ months.
(94) Reduce 4 m. $1\frac{1}{2}$ w. to the decimal of 1 y. 2 m. 3 w.

(95) Reduce $\left(\frac{5\frac{1}{2} + \frac{1}{3}}{\frac{1}{4} + \frac{1}{6}}\right)$ of a week to the decimal of $\frac{2\frac{1}{3}}{4\frac{1}{3}}$ of a year.

Section 16.

(96) Find the value of ·05678 of a month.

(97) Find the value of 1·0467 of 3 months.

(98) Find the value of $\frac{1}{3}$ of 29·567 of a year.

(99) Find the value of $\frac{2\cdot04}{5\cdot06}$ of $\frac{3}{8}$ of a month.

(100) Find the value of $\frac{4\cdot05}{\cdot005}$ of $\frac{1}{12}$ of a year.

(101) Find the value of $\frac{7}{8}$ of 1·4168 of a day.

(102) Reduce 2 feet $6\frac{3}{8}$ ins. to the decimal of $1\frac{1}{2}$ yards.

DECIMAL COINAGE.

10 mille = one cent.
10 cent = one florin.
10 florin = one pound sterling.
960 farthings = one pound sterling.
1000 milles = one pound sterling.

The reading of 52·346 is 52 pounds, 3 florins, 4 cents, and 6 milles.

To reduce, shillings, pence, and farthings to florins, cents, and milles.

RULE.—Reduce the shillings, pence, and farthings to the decimal of a pound sterling; then the three first decimal figures will express the value of the shillings, pence and farthings, in florins, cents, and milles.

EXAMPLES.

Find the value of 5*s*. 6*d*. in florins, cents, and milles.

12) 6·
2,0) 5·5
·275

Then 5*s*. 6*d*. is equal to 2 florins, 7 cents, and 5 milles.

Find the value of 15*s.* 8¾*d.* in florins, cents, and milles.

4)3·0
12)8·75
2,0)15·729
·7864

Then, 15*s.* 8¾*d.* is equal to 7 florins, 8 cents, and 6 milles, and a little more.

Find the value of the following,—

Section 1.

(1) 18*s.* 4*d.* (2) 15*s.* 9*d.* (3) 17*s.* 2*d.* (4) 11*s.* 6*d.*
(5) 19*s.* 3*d.* (6) 13*s.* 5*d.*

Section 2.

(7) 9*s.* 3*d.* (8) 9*s.* 4*d.* (9) 17*s.* 5*d.* (10) 18*s.* 7*d.*
(11) 15*s.* 8*d.* (12) 14*s.* 1*d.*

Section 3.

(13) 15*s.* 7½*d.* (14) 13*s.* 4¾*d.* (15) 5*s.* 6¼*d.* (16) 15*s.* 3½*d.*
(17) 3*s.* 3½*d.* (18) 5*s.* 7½*d.*

Section 4.

(19) 9*s.* 3¼*d.* (20) 15*s.* 4*d.* (21) 11*s.* 3*d.* (22) 13*s.* 9*d.*
(23) 4*s.* 5*d.* (24) 8*s.* 7½*d.*

Section 5.

(25) 18*s.* 3¼*d.* (26) 15*s.* 4¾*d.* (27) 0*s.* 9½*d.* (28) 10*s.* 5¾*d.*
(29) 18*s.* 10¾*d.* (30) 13*s.* 4½*d.*

Section 6.

(31) 5*s.* 7¾*d.* (32) 13*s.* 9¾*d.* (33) 14*s.* 11¾*d.* (34) 6*s.* 7¾*d·*
(35) 14*s.* 1½*d.* (36) 19*s.* 7½*d.*

Section 7.

(37) 3*s.* 4½*d.* (38) 4*s.* 5½*d.* (39) 17*s.* 6½*d.* (40) 13*s.* 10½*d*
(41) 11*s.* 6¾*d.* (42) 8*s.* 3½*d.*

Section 8.

(43) 14*s.* 10¼*d.* (44) 3*s.* 7¾*d.* (45) 5*s.* 6¾*d.* (46) 1*s.* 3¾*d*
(47) 2*s.* 6*d.* (48) 3*s.* 4½*d.*

Section 9.

(49) 7*s*. 6*d*. (50) 13*s*. 4*d*. (51) 17*s*. 6*d*. (52) 6*s*. 4*d*.
(53) 3*s*. 4*d*. (54) 5*s*. 9*d*.

Section 10.

(55) 15*s*. 8½*d*. (56) 5*s*. 6½*d*. (57) 5*s*. 3½*d*. (58) 13*s*. 4*d*.
(59) 1*s*. 8½*d*. (60) 12*s*. 4*d*.

To reduce Florins, Cents., and Milles to Shillings, Pence, and Farthings.

RULE.—Multiply by 20, 12, and 4, observing to mark the decimal point in accordance with multiplication of decimals.

EXAMPLES.

Find the value of ·785 or 7 florins, 8 cents, and 5 milles.

$$\begin{array}{r} \cdot785 \\ 20 \\ \hline 15\cdot700 \\ 12 \\ \hline 8\cdot4 \\ 4 \\ \hline 1\cdot6 \end{array}$$

Hence, ·785 is equal to 15*s*. 8¼⅗*d*.

Find the value of the following.

Section 1.

(1) ·784 (2) ·314 (3) ·432 (4) ·915
(5) ·704 (6) ·834 (7) ·512

Section 2.

(8) ·5678 (9) ·4056 (10) ·347 (11) ·9187
(12) ·8091 (13) ·3014 (14) ·8067

Section 3.

(15) .1416 (16) 3·1567 (17) 5·1368 (18) ·104
(19) ·341 (20) ·506 (21) .7856

Section 4.

(22) 18·5678 (23) 5·3046 (24) 9·3146 (25) ·946
(26) ·107 (27) ·204 (28) ·5675

Section 5.

(29) 1·5067 (30) 1·8007 (31) 4·0467 (32) ·026
(33) ·007 (34) 1·007 (35) ·8403

Section 6.

(36) 42·0067 (37) 8·0407 (38) 3·1046 (39) ·1234
(40) ·4321 (41) ·5678 (42) ·8765

Section 7.

(43) 8·70467 (44) 7·4053 (45) 1·0479 (46) ·5967
(47) ·7695 (48) ·6401 (49) ·76

Section 8.

(50) 13·1313 (51) 14·14147 (52) 2·6676 (53) ·8899
(54) ·9988 (55) ·7767 (56) ·7677

Table for changing Shillings, Pence, and Farthings into Florins, Cents, and Milles.

fa.		*fl.*	*c.*	*m.*
1	=	0	0	1·041
2	=	0	0	2·083
3	=	0	0	3·125

d.		*fl.*	*c.*	*m.*
1	=	0	0	4·16
2	=	0	0	8·33
3	=	0	1	2·5
4	=	0	1	6·66
5	=	0	2	0·83
6	=	0	2	5·
7	=	0	2	9·16
8	=	0	3	3·33
9	=	0	3	7·5
10	=	0	4	1·66
11	=	0	4	5·83

s.		*fl.*	*c.*	*m.*
1	=	0	5	0
2	=	1	0	0
3	=	1	5	0
4	=	2	0	0
5	=	2	5	0
6	=	3	0	0
7	=	3	5	0
8	=	4	0	0
9	=	4	5	0
10	=	5	0	0
11	=	5	5	0
12	=	6	0	0
13	=	6	5	0
14	=	7	0	0
15	=	7	5	0
16	=	8	0	0
17	=	8	5	0
18	=	9	0	0
19	=	9	5	0

Table for changing Florins, Cents, and Milles into Shillings, Pence, and Farthings.

fa.		*s.*	*c.*		*d.*	*m.*		*d.*	*fa.*
1	=	2	1	=	0 2¼⅗	1	=	0	0$\frac{24}{25}$
2	=	4	2	=	0 4¾⅕	2	=	0	1$\frac{23}{25}$
3	=	6	3	=	0 7 ⅘	3	=	0	2$\frac{22}{25}$
4	=	8	4	=	0 9½⅖	4	=	0	3$\frac{21}{25}$
5	=	10	5	=	1 0	5	=	1	0 ⅘
6	=	12	6	=	1 2¼⅗	6	=	1	1$\frac{19}{25}$
7	=	14	7	=	1 4¾⅕	7	=	1	2$\frac{18}{25}$
8	=	16	8	=	1 7 ⅘	8	=	1	3$\frac{17}{25}$
9	=	18	9	=	1 9½⅖	9	=	2	0$\frac{16}{25}$

EXAMPLE.—Change 13*s.* 5½*d.* to florins, cents, and milles.

		fl.	*c.*	*m.*
From the table 13*s.*	=	6	5	0
5*d.*	=	0	2	0·83
½*a.*	=	0	0	2·083
Then, 13*s.* 5½*d.*	=	6	7	2·916

Therefore, 13*s.* 5½*d.* is equal to 6 florins, 7 cents, and 3 milles.

EPAMPLE.—Change 3*fl.* 4*c.* 7*m.* to shillings, pence, and farthings.

		s.	*d.*
From the table . . 3*fl.*	=	6	0
4*c.*	=	0	9½ ⅖
7*m.*	=	0	1½$\frac{18}{25}$
Then 3*fl.* 4*c.* 7*m.*	=	6	11¼

Or, 3*fl.* 4*c.* 7*m.* are equal to 6*s.* 11¼*d.*

PROPORTION.

Section 1.

(1) If 8 men can do a piece of work in 17 days, in how many days will 34 men do it?

(2) If 7 yards of cloth cost 8*l.*, how many yards can be bought for 72*l.*?

(3) Cloth is bought at 9*s.* per yard; what will 84 yards cost?

(4) Deal boards are bought at the rate of 16*s.* for 8 square feet; how many feet will 3*l.* 4s. buy?

Section 2.

(5) A vessel sails 28 knots in 3 hours; in what time will it make a journey of 1988 knots?

(6) In what time will 7 men build a boat, if 2 men can build a boat in 28 months?

(7) A person performs a journey of 180 miles in 24 days; in how many days would he perform a journey of 2700 miles?

(8) If 17 men receive 33*l.* per week, what amount will be required to pay 153 men?

Section 3.

(9) If 6 men will do a piece of work in 42 days, how many men will do 3 times the work in 126 days?

(10) A friend lent me 135*l.* for 18 months; for what time should I lend him 162*l.* in return?

(11) If 36 shilling-loaves can be made from a quantity of flour, what will be the price of a loaf if 48 loaves be made from the same quantity of flour?

Section 4.

(13) A ship is provisioned for 4 months, at the rate of 15 ozs. per day for each day; how must the provisions be distributed so that they may last 5 months?

(14) A ship is provisioned for 4 months, at the rate of 15 ozs. a day for each man; how long will the provisions last if each man is allowed 10 ozs. per day?

(15) A farm of 36 acres is let for 99*l.* per annum; what would be the rent of a farm of 308 acres?

(16) The wages of 26 men amount to 32*l.* 10*s.* per week; what amount would be required to pay 84 men? and what are the wages of one man?

Section 5.

(17) The interest of 100*l.* for 1 year is 5*l.* 10*s.*; what will be the interest of 350*l.* for 1 year?

(18) What will be the interest of 850*l.* at 5 per cent per annum?

(19) What will be the interest of 1008*l.* at 4½ per cent per ann.?

Section 6.

(20) If 6 men can do a piece of work in 15 days, how many men will do it in 45 days?

(21) If 7 horses can plough a field in 5 days, in how many days will 21 horses plough it?

(22) If 84 men can build a boat in 2 months, in what time will 12 men build it? and how many men will build it in 7 months?

(23) If coals be bought for 22*s.* per ton, and sold at 24*s.*, what is the gain per cent.?

Section 7.

(24) If 77 bushels of oats will serve 9 horses for 16 weeks, how long will they serve 32 horses?

(25) If 8 men can do a piece of work in 6 days, how many men will do it in 24 days? and in what time will 26 men do it?

(26) If 12 bushels of wheat cost 18*l.*, what will 88 bushels cost? and how many bushels can be purchased for 88*l.*?

Section 8.

(27) The annual rent of 84 acres is 252*l.*; what is the rent of 132 acres? how many acres will produce 1000*l.* a year? and what is the rental per acre?

(28) If the coachfare for 77 miles be 22*s.*, what will be the cost of a journey of 364 miles? and the rate per mile.

(29) If 66 men can do a piece of work in 7 months, in what time will 231 men finish three times the work? and how many men will complete half the work in 231 months?

Section 9.

(30) If a ship can be built by 164 men in 14 months, in what time will 82 men build ⅛ of it? and how many men will build ⅜ of it in 21 months?

(31) If ⅜ of a ship can be built by 168 men in 18 months, in what time will 90 men finish it? and in what time will 1 man build ⅛ of it? and how many men will finish it in 72 months?

(32) One cubic foot of water weighs 62½ ponnds; what will be the weight of water contained in 5¼ cubic feet?

Section 10.

(33) If 8 men can do a piece of work in 5⅛ weeks, in what time will 51 men do 2⅛ times the work ?

(34) If 99 men can build ⅜ of a vessel in 10 months, how many men wi llfinish it in 55 months ?

(35) If 108 men can do 1⅛ work in 9 months, in what time can 76 men do 2⅜ work ?

Section 11.

(36) If 1 ton of iron be worth as much as 15 cwt. of brass, how much iron must be given in exchange for 27 tons of brass ?

(37) If 3½ tons of brass be worth as much as 2⅓ tons of lead, how much brass must be given in exchange for 66 tons of lead ?

(38) If 54 tons of coals are worth as much as 3⅛ tons of lime, how much lime must be given in exchange for 648 tons of coal ?

(39) If a boy spends 8*s.* 4*d.* per month, when the month contains 28 days, what will serve 6 boys 4 months, when they contain 30 days ?

(40) If 12 apples be worth 21 pears, and pears be sold at 21 for 7*d.*, what is the price of 84 apples ?

Section 12.

(41) A wrought-iron rod of one square inch of section will just break with a force of 24 tons applied in the direction of its length, what will be the section of a rod to bear 84 tons, and how many tons will a rod of 2½ square inches bear ?

(42) If a tax of 6*l.* be made on a rental of 125*l.*, what will be the tax on 225*l.* ? and what rental will produce a tax of 20*l.* 10*s.* ?

(43) If 450*l.* be borrowed 24 months, how long a time must 150*l.* be lent in return ? and what amount must be lent in return for 42 months ?

(44) If 52 shilling loaves he made of a quarter of wheat, what will be the price of a loaf if 64 are made of the same quantity of wheat ?

Section 13.

(45) A ship is provisioned for 14 months at the rate of 16 ounces per man per day ; how many ounces must each man have per day, in order to make the provisions last 18 months? and how many months will the provisions last if each man had 21 ounces per day ?

Section 13.—(*continued*)

(46) A man will finish his journey in 9 weeks by travelling 8 hours per day; in how many weeks will he complete a journey twice as long, by travelling 10 hours per day? and how many hours per day must he travel to complete his journey in 8 weeks?

(47) How many yards of planking 1 foot 6 inches wide will cover a floor containing 72 square yards?

Section 14.

(48) If the penny-loaf weighs 4 ounces when wheat is at 7*s.* 6*d.* per bushel, what will it weigh when wheat is at 6*s.* 6*d.* per bushel? and what is wheat per bushel when the penny-loaf weighs $6\frac{1}{2}$ ounces?

(49) If 14 men earn 24*l.* 10*s.* in a week, what will 84 men earn in the same time? and how many men will earn 147*l.* in a week?

(50) If 54 men can do a piece of work in 36 days, how many men can do three times the work in 72 days?

Section 15.

(51) A piece of gold weighs $14\frac{3}{5}$ ounces, and is valued at $513\frac{3}{5}$*l.*; what is the value of $9\frac{1}{8}$ ounces?

(52) What is the value of $\frac{5}{8}$ of $\frac{16}{15}$ of a prize, when $\frac{4}{5}$ of it is worth 8042*l.* 16*s.* $10\frac{1}{2}$*d.*?

(53) If the rent of a farm be 850*l.* 3*s.* 4*d.* per annum, and the taxes 12*l.* 8*s.* per 100*l.*, what will be the annual expenses of the farmer?

Section 16.

(54) If 106 men can do a piece of work in $3\frac{1}{2}$ months, in what time will 53 men do it? and how many will do it in 7 months?

(55) If 25 men can do a piece of work in 40 days, working 9 hours per day, how many men will do it in 75 days, working 8 hours per day? and how many days will 125 men do it in working 8 hours per day?

(56) If 450 men can build a ship in $15\frac{1}{2}$ weeks, working 6 days per week, in how many weeks will 108 men do it working 5 days per week? how many men will do it in 31 weeks working 10 days per week? how many days per week must 279 men work to do it in 15 weeks?

Section 17.

(57) If 117 pecks of oats will serve 12 horses 3½ weeks, how many weeks will 54 pecks serve 13 horses ? and how many pecks will serve 39 horses 9⅓ weeks ?

(58) If 64 men can build an engine in 5¼ months, working 26 days per month, how many men will build it in 16 months, working 21 days per month ? and in what time will 39 men build it, working 25⅗ days per month ?

Section 18.

(59) If 10 men can saw 5 planks, 20 feet long and 3 feet deep, in 3 hours, how many men will saw 25 planks, 24 feet long, and 2⅓ feet deep, in 14 hours ? and in what time will 35 men saw 105 planks, 34 feet long and 2 feet 3 inches deep ?

(60) If $\frac{7}{18}$ of a piece of work can be done by 82 men in 8½ months, working 28 days per month, in what time will 102 men finish the remainder, working 31½ days per month? and how many men will do $\frac{1}{18}$ of the work in 3¾ months, working 12$\frac{8}{13}$ days per month ?

Section 19.

(61) If 12 workmen can do a piece of work in 5 months, when they contain 35 days, how long will 30 men be in doing four times the work when a month contains 28 days ?

(62) If ⅜ of a ship is built by 150 men in 60½ days, working 10½ hours per day, how long will 300 men be in finishing it, working 8½ hours per day ?

(63) If a boat can be built by 5 men in 15 days, working 12 hours per day, how many hours per day must 21 men work to build ⅞ of it in 6 days ?

Section 20.

(64) If ⅜ of a ship can be built by 350 men in 8 months, working 10¼ hours per day, in how many months will 450 men finish it, working 8⅓ hours per day ?

(65) If 100 men build a mansion in 42 weeks, working 10⅓ hours per day, in how many weeks will 84 men build it, working 12¼ hours per day ?

(66) If 104 men build ⅜ of a mansion in 84 weeks, working 9 hours per day, in how many weeks will 106 men build ⅝ of it, working 10 hours per day ?

Section 21.

(67) If 8 men will do a piece of work in 10 days, by the assistance of 6 boys, and the boys alone would do it in 25 days, how many days will one man be in doing the work ?

(68) Two taps, A and B, can fill a cistern, holding 100 gallons, in 3 and 5 hours respectively, in what time will they fill the cistern, both running together ?

(69) If 2 boys can spend 3s. 6d. in five days, when the days are 16 hours long, how much money will serve 6 boys (treble the spendthrifts) 6 days, when the days are 12 hours long ?

Section 22.

(70) If 15 masons can build a wall 25 feet long, 6 feet high, 1 foot 2 inches thick, in 8½ days, working 10¼ hours per day; in how many days will 17 masons build a wall 35 feet long 7 ft. high and $2\frac{2}{7}$ thick, working 13⅔ hours per day?

(71) If 20 horses can plough 130 acres of land in 26 days, how many horses will be required to plough 100 acres in 40 days?

(72) How many men will be required to reap a field of 25 acres in 32 days, when 120 men can reap 75 acres in 40 days?

Section 23.

(73) If 220 men can do a piece of work in 60 days, of 8 hours each, how many men will it take to do thrice the work in 180 days, of 11 hours each?

(74) If 160 men can build a house in 112 days, working 10 hours per day, how many men must be employed to build 12 such houses, in 96 days of 7 hours each? and also to build 20 houses in 200 days, of 8 hours each?

(75) If 5 mills grind 150 sacks of flour in 6 weeks, working 6 days per week, how many sacks will 12 mills grind in 10 weeks working 3 days per week?

Section 24.

76) If 200 shipwrights can build ⅜ of a ship in 120 days, of 8 hours each, how many men must be employed to finish the remainder in 40 days, of 6 hours each?

Section 24—*(continued.)*

(77) If the carriage of 20 tons cost 2*l.* for 140 miles; how many miles ought 50 tons to be carried for 3*l.*?

(78) If 7 printers can throw off 100 volumes containing 20 sheets per volume in 30 days, of 6 hours each, how many volumes of 30 sheets each, will 12 men print in 40 days, of 8 hours each?

Section 25.

(79) A street of 60 houses can be built by 500 men in 4 months, of 28 days each; how many will build 20 houses in 3 months, of 30 days each?

(80) How many men can finish a piece of work in 14 days of 10 hours each, when 20 men can do $\frac{2}{3}$ of it in 12 days, of 8 hours each?

(81) If I lend a person 200*l.* for 6 months and receive 5*l.* in return for the loan; how long ought I to lend him 500*l.* when I receive 3*l.* for the loan?

Section 26.

(82) If 184 men can build $\frac{7}{8}$ of a ship in $12\frac{1}{8}$ months, working $23\frac{1}{4}$ days per month, in what time will 93 men finish it working $19\frac{2}{7}$ days per month? and how many men will build $\frac{3}{8}$ of it in $13\frac{6}{7}$ months, working $23\frac{1}{4}$ days per month?

(83) If 19 men, working $12\frac{1}{2}$ hours per day, earn 100*l.* 8*s.* 6*d.* in 29 days; how many hours per day must 25 men work to earn 803*l.* 8*s.* in 72 days?

Section 27.

(84) A can do a piece of work in 18 days, which B can do in 15, in how many days will A and B together do it?

(85) A can do a piece of work in 21 days, which can be done by A and B together in 14 days, in what time can B do it alone?

(86) A and B together can do $\frac{1}{2}$ the work in 12 months; and A can do $\frac{1}{3}$ of it in 18 months, in what time will B do $\frac{3}{8}$ of it?

Section 28.

(87) A, B, C, can do a piece of work in 8, 12, 14 days respectively, in how many days will they do it working altogether?

(88) A, B, C, together can do a piece of work in 8 months, A and B can do it in 14 months; C and B can do it in 12 months; in what time can each do it alone?

Section 29.

(89) 25 gallons had been drawn from a barrel of beer, ⅙ of which had leaked away, and it then remained ⅔ full; how much does the barrel hold?

(90) A can do a piece of work in 12 days which B can do in 9; after A has been at work upon it 4 days B comes to help him, in what time will they finish it?

(91) A and B together can reap a field in 5½ days, which A alone could reap in 7¾ days, in what time can B alone reap it?

Section 30.

(92) A cistern can be filled in 2 hours by a pipe A, and emptied in 1½ hours by a pipe B;, after A has been opened 15 minutes B is is opened, find the time of emptying the cistern.

(93) A can do a piece of work in 24 days, but with the assistance of B for 7 days he could do it in 18 days, in what time could B do it?

(94) A and B together can do a piece of work in 8 days, A and C together in 10 days, B and C together in 12 days, in what time will each do it alone?

Section 31.

(95) A can mow 5 acres of grass in 3 days, B can mow 7 acres in 9 days, and C can mow 11 acres in 12 days, in how many days can they jointly mow 121 acres?

(96) A and B can do a piece of work in 8 and 100 days respectively; they work together for 4 days when A leaves, and B continues, but after 6 days is joined by C, who finish it together in 30 days; in what time would C do it alone?

(97) A starts from Portsmouth to London at the rate of 3¾ miles per hour, to meet B who starts from London at the same time, and rides to Portsmouth at the rate of 8½ miles per hour, when and where will they meet? the distance being 98 miles.

Section 32.

(98) The mail train leaves London at 10 o'clock in the morning, and arrives at Portsmouth at ¼ past 1. The parliamentary train leaves Portsmouth at a ¼ past 6 o'clock in the morning, and arrives in London at ½ past 11. When and where do the trains meet? the distance between London and Portsmouth being 89 miles.

Section 32—*(continued.)*

The mail runs 89 miles in 3¼ hours, or $\frac{356}{13}$ miles per hour.

The parliamentary train runs 89 miles in 5¼ hours, or $\frac{356}{21}$ miles per hour.

The distance run by the parliamentary train from a ¼ past 6 o'clock to 10 o'clock is $\frac{15}{4} \times \frac{356}{21} = \frac{445}{7}$ miles.

$\therefore$ $89 - \frac{445}{7} = \frac{178}{7}$ miles which remain to be run over.

And $\frac{356}{13} \times \frac{356}{21} = \frac{12104}{273}$ miles per hour, rate of advance of the trains.

Then, $\frac{178}{7} + \frac{12014}{273} = \frac{178}{7} \times \frac{273}{12104} = \frac{3471}{6052}$ hours = 34 m. 24½ s. past 10 o'clock when the trains meet.

And $\frac{3471}{6052} \times \frac{356}{13} = 15\frac{13884}{19669}$ miles from London where they meet.

(99) The parliamentary and express leave London at a ¼ past 6 and 8 o'clock respectively, and arrive at Birmingham at 12 and 11 o'clock respectively. When and where does the express overtake the parliamentary train, and what is the distance between the two trains at 9 o'clock? the distance from London to Birmingham being 110 miles.

INTEREST.

Interest is an equivalent for the use of money; and it is generally reckoned by a certain sum for the use of a 100*l.* for one year. Thus, if 5*l.* be received for the loan of 100*l.* for one year, it is commonly called 5 per cent. per annum.

Section 1.

(1) Find the interest of 300*l.* at 5 per cent. per annum.

(2) Find the interest of 450*l.* at 4 per cent. per annum for 2 years.

(3) Find the interest of 875*l.* at 3 per cent. per annum for 3 years.

(4) Find the interest of 1500*l.* at 3½ per cent. per annum for 3½ years.

Section 2.

5) What is the amount of 156*l.* at 5 per cent. per annum for 2 years?

(6) What is the interest of 175*l.* at 3¾ per cent. per annum for 4¾ years?

(7) Find the interest on 564*l.* at 4 per cent. per annum for 3 years.

(8) Find the interest of 845*l.* at 4½ per cent. per annum for 2½ years.

Section 3.

(9) Discount a bill of 150*l.* at 3½ per cent.

(10) Discount a bill of 225*l.* at 5 per cent.

(11) Discount a bill of 325*l* at 4½ per cent.

(12) What has to be paid on a bill of 160*l*, allowing discount at 5½ per cent.?

(13) Discount a bill of 850*l.* at 4¾ per cent.

Section 4.

(14) Find the interest of 325*l.* 10*s.* at 4½ per cent. per annum for 3 years.

(15) Find the interest of 945*l.* 12*s.* 6*d.* at 4½ per cent. per annum for 7 years.

(16) Find the amount of 189*l.* 10*s.* 10*d.* at 2½ per cent. per annum for 3½ years.

(17) Find the interest of 1045*l.* 17*s.* 9½*d.* at 3¾ per cent. per annum for 5½ years.

Section 5.

(18) What is the discount on a bill of 450*l.* at 3½ per cent ?
(19) What is the discount on a bill of 455*l.* at 3¼ per cent ?
(20) What is the discount on a bill of 354*l.* 10*s.* at 5 per cent ?
(21) What is the discount on a bill of 345*l.* 14*s.* 8*d.* at 3¾ per cent ?
(22) What is the discount on a bill of 345*l.* at 3 per cent ?
(23) What is the discount on a bill of 348*l.* 10*s.* 6*d.* at 4½ per cent ?

Section 6.

(24) Find the amount of 1450*l.* 16*s.* 8½*d.* at 2½ per cent. per annum for 7 years.
(25) Find the interest on 175*l.* 19*s.* 9¾*d.* at 2¾ per cent. per annum for 5½ years.
(26) Find the amount of 5,555*l.* 5s. 5*d.* at 5⅛ per cent. per annum for 5⅛ years.
(27) Find the interest of 345*l.* 10*s.* 3¼*d.* at 4 per cent. per annum for 3½ years.

Section 7.

(28) Find the discount on a bill of 874*l.* 10*s.* 8¾*d.* at 4¾ per cent.
(29) What has to be paid on a bill of 4,011*l.* 19*s.* 9¾*d.* at 5¾ per cent discount ?
(30) What has to be paid on a bill of 2,401*l.* 14s. 6½*d.* at 4¾ per cent. discount.
(31) What has to be paid on a bill of 1,009*l.* 9*s.* 2*d.* at 4 per cent. discount ?
(32) What has to be paid on a bill of 1,000*l.* at 3¾ per cent. discount?
(33) What has to be paid on a bill of 1,001*l.* 19*s.* 9¼*d.* at $2\frac{1}{16}$ per cent discount.

Section 8.

(34) Find the interest on 335*l.* for 3 calendar months, at 3 per cent per annum.
(35) What is the amount of 375*l.* for 6 months, at 5 per cent. per annum ?
(36) Find the interest of 395*l.* 5*s.* 6*d.*, for 8 months, at 3¼ per cent per annum.
(37) What is the interest of 1,000*l.* 19*s.* 9¾*d.*, for 9 months, at 4 per cent. per annum.
(38) What is the interest of 148*l.* 10*s.* 8½*d.*, for 5 months, at 4¾ per cent. per annum.

Section 9.

(39) Find the discount on a bill of 180*l.* 18*s.* 7*d.* at 4½ per cent.

(40) What has to be paid on a bill of 315*l.* 10*s.* 8*d.* at 8½ per cent. discount.

(41) What is the amount of 456*l.* 14*s.* 8½*d.*, for 10 months, at 3½ per cent. per annum.

(42) Find the amount of 346*l.* 16*s.* 7¾*d.*, for 2 years and 4 calendar months, at 4¾ per cent. per annum.

(43) Find the amount of 146*l.* 14*s.* 8¾*d.*, for 3 years and 10 months, at 4⅝ per cent. per annum.

(44) Find the amount of 1,468*l.* 15*s.* 9¾*d.*, for 6 years and 9 months at 5⅜ per cent. per annum.

Section 10.

(45) Find the amount of 458*l.* 16*s.* 9½*d.*, for 8 years and 3 months, at 3⅝ per cent. per annum.

(46) Find the interest of 386*l.* 19*s.* 9¾*d.*, for 7 months, at $4\frac{7}{12}$ per cent per annum.

(47) Find the interest of 1,486*l.* 18*s.* 10½*d.*, for 1 year and 8 months at $3\frac{5}{12}$ per cent per annum.

(48) Find the amount of 450*l.* 10*s.* 6*d.*, for 8 months, at 3 per cent. per annum.

(49) Find the amount of 845*l.* 12*s.* 8½*d.*, for 6 months, at 2½ per cent. per annum.

(50) Find the interest of 315*l.* 15*s.* 7*d.*, for 4 months, at 3½ per cent. per annum.

Section 11.

(51) What is the amount of 345*l.* 6*s.* 3½*d.*, for 4 months, at 3 per cent. per annum?

(52) What is the amount of 146*l.* 6*s.* 8¼*d.*, for 2 years, at 4*l.* 5*s.* per cent. per annum.

(53) What is the amount of 184*l.* 6*s.* 8¾*d.*, for 2⅓ years, at 4¾ per cent. per annum.

(54) What is the interest of 1,008*l.* 16*s.* 8¼*d.*, for 8 years, at 3 per cent. per annum?

(55) What is the interest of 385*l.* 7*s.* 9¼*d.*, for 4 years, at 3½ per cent. per annum?

(56) Find the amount of 1,004*l.* 6*s.* 5¾*d.* for 2½ years, at 2½ per per cent. per annum.

Section 12.

(57) What principle will produce an interest of 12*l.* 9*s.* 3*d.* in 3 years, at 5 per cent. per annum?

Section 12—(*continued.*)

(58) What principle will produce an interest of 30*l.* at 4 per cent. per annum?

(59) What principle will produce an interest of 184*l.* 3*s.* 6*d.* for 2 years, at 3½ per cent. per annum?

Section 13.

(60) What principal will give an interest of 25*l.*, for 1 year, at 5 per cent. per annum ?

(61) What principal will give an of 58*l.*, in 3 years, at 4 per cent. per annum ?

(62) What principal will give an interest of 104*l.*, in 4 years, at 5 per cent. per annum ?

(63) What principal will give an interest of 168*l.* in 6 years, at 4 per cent. per annum?

Section 14.

(64) What principal will give an interest of 60*l.* in 3 years, at 3 per cent. per annum ?

(65) What principal will give an interest of 80*l.* in 4 years, at 4 per cent. per annum ?

(66) What principal will give an interest of 80*l.* 10*s.* 10*d.* in 2½ years, at 3 per cent. per annum?

Section 15.

(67) What principal will give an interest of 104*l.* in 2½ years, at 3½ per cent per annum ?

(68) What principal will give an interest of 50*l.* in 5¼ years, at 2½ per cent. per annum ?

(69) What principal will give an interest of 84*l.* in 2 years, at 3 per cent. per annum ?

Section 16.

(70) What principal will give an interest of 35*l.* 6*s.* in 3 years, at 4 per cent. per anuum ?

(71) What principal will give an interest of 350*l.* in 1 year, at 3¼ per cent. per annum ?

(72) What principal will give an interest of 300*l.* in 3 years, at 3 per cent. per annum?

Section 17.

(73) In what time will 600*l.* produce an interest of 35*l.*, at 4½ per cent. per annum ?

(74) In what time will 3450*l.* produce an interest of 104*l.*, at 5½ per cent. per annum ?

Section 17—(*continued.*)

(75) In what time will 34567*l.* produce an interest of 350*l.* at 3½ per cent. per annum ?

(76) In what time will 1456*l.* produce an interest of 344*l.* at 2½ per cent. per annum ?

Section 18.

(77) In what time will 1456⅓*l.* produce an interest of 346*l.* at 3¼ per cent. per anuum ?

(78) In what time will 1345*l.* 6*s.* 8*d.* produce an interest of 304*l.* 6*s.* 8*d.* at 3¾ per cent. per annnm ?

(79) In what time will 134*l.* double itself at 3 per cent. per ann. ?

(80) In what time will 200*l.* treble itself at 3½ per cent. per ann. ?

Section 19.

(81) In what time will 350*l.* 13*s.* 4*d.* double itself at 4½ per cent. per annum ?

(82) In what time will 1000*l.* double itself at 5½ per cent. per annum ?

(83) In what time will 650*l.* amount to 700*l.* at 3½ per cent. per annum ?

(84) In what time will 356*l.* 15*s.* amount to 840*l.* at 3¾ per cent. per annum ?

Section 20.

(85) The principal, 550*l.*, amounts to 728*l.* 15*s.* in 6½ years, find the rate per cent.

(86) The principal, 630*l.*, amounts to 762*l.* 6*s.* in 7 years, find the rate per cent.

(87) The principal, 1000*l.*, amounts to 1390*l.* in 9¾ years, find the rate per cent.

Section 21.

(88) The principal, 136*l.* 14*s.* 6*d.*, amounts to 229*l.* 0*s.* 3¼ ⅘ in 15 years, find the rate per cent.

(89) The principal, 567*l.* 18*s.* 3*d.* amounts to 823*l.* 9*s.* 5½⅓*d.* in 12 years, find the rate per cent.

(90) The principal, 1304*l.* 10*s.*, amounts to 1549*l.* 1*s.* 10½*d.* in 7½ years, find the rate per cent.

Section 22.

(91) The principal, 568*l.* 4*s.*, trebles itself in 50 years, find the rate per cent.

(92) The principal, 1000*l.*, becomes 1500*l.* in 13½ years, find the rate per cent.

Section 22—*(continued.)*

(93) The principal, 500*l.*, becomes 780*l.* in $13\frac{3}{17}$ years, find the rate per cent.

(94) The principal, 730*l.*, becomes 935*l.* in $8\frac{608}{949}$ years, find the rate per cent.

Insurance is a per centage which is paid for the security of property from fire and other liabilities. The per centage is regulated in amount by the nature and hazards to which the property insured is exposed. The whole annual payment for property insured is called the *premium*, and the document which secures the insurer from loss, so long as he pays the premium, is called the *policy of insurance.*

Commission is a per centage which is paid to an agent for buying and selling goods.

Brokerage is a per centage which is usually made to an agent for transacting money concerns..

Insurance, *Commission*, *Brokerage*, as well as discount, are cases of simple interest.

Section 23.

(95) Find the premium on a building worth 306*l.* 18*s.* 7d. at 3½ per cent.

(96) Find the premium on a building worth 3084*l.* 19*s.* 11½*d.* at 4*l.* 2*s.* per cent.

(97) Find the premium for insuring a vessel and cargo worth 20,345*l.* 16*s.* 8*d.* at 2⅛ per cent.

Section 24.

(98) Find the premium on a factory insured at 3045*l.* at 2*l.* 8*s.* 6*d.* per cent.

(99) Find the premium on a policy of life insurance for 506*l.* 13*s.* 9*d.* at 5*l.* 9*s.* 6*d.* per cent.

(100) What would be the cash payment of a bill of 3045*l.* 19*s.* 9½*d.* at 3*l.* 4*s.* 6*d.* per cent. ?

(101) Find the commission on 3046*l.* 7*s.* 9*d.* at 1*l.* 17*s.* 6*d.* per cent.

Section 25.

(102) Find the brokerage on 3456*l.* 17*s.* 9*d.* worth of railway-shares at 5*s.* 9*d.* per cent ?

(103) Find the brokerage on the sale of a building and appurtenances amounting to 2406*l.* 15*s.* 10*d.* at 1*s.* 3½*d.* per cent.

(104) What is the premium on a ship worth 70045*l.* 14*s.* 7*d.* at 2*l.* 17*s*· 6*d.* per cent. ?

(105) Find the commission on the sale of a house and appurtenances whose value is 4567*l.* 17*s.* 11*d.* at 3*s.* 1*d.* per cent.

Section 26.

(106) Find the insurance at 3 per cent. on a house worth 374*l.*, so that in case of loss the insurer shall receive the value of the house and premium.

(107) Find the insurance of a factory worth 2047*l.* at 1*l* 18*s.* 6*d.* per cent., so that the owner, in case of loss, may receive the value of the factory and premium.

(108) Find the premium on a policy of 3467*l.* 14*s.* 7*d.* at 3*l.* 14*s.* 6*d.* per cent.

Section 27.

(109) What is the brokerage on a sale of 3456*l.* 11*s.* 9*d.* at 4½*d.* per cent ?

(110) Find the commission on a transaction of 305*l.* 5*s.* 7*d.* at 5 per cent.

(111) What is the insurance of a building worth 3004*l.* 14*s.* 8*d.* at 2*l.* 2*s.* 6*d.* per cent., so that the owner, in case of loss, may receive the value of the building and premium.

Section 28.

(112) Find the premium on a policy of 5340*l.* 17*s.* 4*d.* at 2*l* 13*s.* 4*d.* per cent.

(113) For what sum should a building worth 3047*l.* 17*s.* 8*d.* be insured at 3*l.* 4*s.* 6*d.* per cent., so that the owner, in case of loss, may receive the value of the building and premium ?

(114) Find the brokerage on a sale of 5067*l.* 15*s.* 9*d.* at 3½d. per cent ?

STOCK is money lent to some government or trading company at a certain rate of interest.

If money was always of the same value 100*l.* of *Stock* would be worth 100*l.* ; but this is not the case, as there are many causes which raise or lower the value of money. If money be making a higher or less rate of interest than the rate of interest of the Stocks, the price of Stock will fall or rise.

Thus, if a person, possessing 100*l. stock at* 3 *per cent., wanted to sell it when money was making* 4 *per cent., it is clear that no one wonld give him* 100*l. for the right to receive only* 3*l.*, *when* 4*l. could be obtained by other means for the same sum.*

Now, 75*l. at* 4 *per cent. will produce* 3*l. or* 75*l. sterling will be worth as much as* 100*l. stock, since they produce the same amount of interest,* 3*l.; hence, a person holding stock at* 3 *per cent. would be able to sell it at* 75*l. for every* 100*l., or the price of* 3 *per cents would be* 75*l.*

Section 29.

(115) Find the income of 10,000*l.* invested in the 3 per cents. at 79*l.*

(116) Find the income of 5678*l.* invested in the 3½ per cents. at 84⅛*l.*

(117) Find the income of 345*l.* invested in the 4 per cents. at 93⅜*l.*

(118) Find the income of 3467*l.* invested in the 3 per cents. at 84½*l.*

Section 30.

(119) Transfer 3000*l.* stock from the 4 per cents. at 93, to 3½ per cents. at 84, and find the difference in the income.

(120) Find the difference per annum between investing 1000*l.* in the 3 per cents. at 74, and in the 4 per cents. at 88.

(121) Find the difference in income by transferring 4000*l.* stock from the 4 per cents. at 87, to the 5 per cents. at 95.

Section 31.

(122) In which is it most advantageous to invest, the 4½ per cents. at 87⅛, or the 5 per cents. at 93⅛ ?

(123) Find the difference in income by the transfer of 3467*l.* stock, from the 3 per cents. at 74, to the 4½ per cents. at 92.

(124) Which is the most advantageous to invest, 1020*l.* in the 3½ per cents. at 85⅛, or 4½ per cents. at 90⅛ ?

(125) Do I lose or gain by the transfer of 1056*l.* stock, from the 3½ per cents. at 87, to the 4 per cents. at 92⅛ ?

Section 32.

(126) What is the cost of 340*l.* in the 3 per cent. consols at 78⅛, allowing ⅛ per cent for brokerage ?

(127) What is the cost of 784 bank stock at 83⅜ allowing ⅜ per cent. for brokerage ?

(128) Find the cost of 855*l.* bank annuities at 94⅜, allowing ¼ per cent. for brokerage ? and what sum would be lost by selling out at 91½ ?

Section 33.

(129) What sum invested in the 4 per cents. at 92, will realise an income of 600*l.* a year, allowing ¼ per cent. for brokerage ?

(130) What sum invested in the 3½ per cents. at 85⅜ will produce an income of 350*l.* per annum, allowing ⅛ per cent. for brokerage?

(13) What sum invested in the 4½ per cents. at 96⅜, will realise a yearly income of 550*l.*, allowing ⅛ per cent. for brokerage ?

COMPOUND INTEREST.

Compound Interest.—If the simple interest at the end of the first year be added to the principal for a second principal, and the interest of the second principal be added to itself for a third principal, and the interest of the third principal be added to itself for a fourth principal, &c., the process is called compound interest.

Section 1.

(1) Find the compound interest of 350*l.* for 3 years at 3 per cent. per annum.

(2) Find the compound interest of 875*l.* for 5 years at 4 per cent. per annum.

(3) Find the compound interest of 3455*l.* for 4 years at 5 per cent. per annum.

Section 2.

(4) Find the amount of 346*l.* for 4 years at 3½ per cent. per annum compound interest.

(5) Find the amount of 5670*l.* for 5 years at 4½ per cent. per annum compound interest.

Section 3.

(6) What is the amount of 304*l.* at 4 per cent. per annum at compound interest for 3 years ?

(7) What is the amount of 504*l.* 10*s.* at 4½ per cent. per annum at compound interest for 4 years ?

Section 4.

(8) What is the amount of 1045*l.* 15*s.* at 3¼ per cent. per annum for 4½ years at compound interest ?

(9) Find the amount of 346*l.* 10*s.* at compound interest for 3 years at 2½ per cent.

Section 5.

(10) Find the amount of 3047*l.* 15*s.* for 3 years at 3¾ per cent. per annum compound interest.

(11) Find the amount of 7532*l.* 16*s.* at compound interest for 3½ years at 4 per cent. per annum.

Section 6.

(12) Find the amount of 1046*l.* 5*s.* at compound interest for 4 years at $2\frac{1}{4}$ per cent. per annum.

(13) Find the amount of 3467*l.* 4*s.* at compound interest for 3 years at $3\frac{3}{4}$ per cent. per annum.

(14) Find the amount of 345*l.* 8*s.* at compound interest for $3\frac{1}{2}$ years at 3 per cent. per annum.

In 1786, when the National Debt amounted to 238 millions, Mr. Pitt proposed, in the House of Commons, that a million per annum should be allowed to accumulate at compound interest till it amounted to four millions; its accumulations were then to cease, and the stock purchased was to be available for the public service.

The fund thus created was called the Sinking Fund.

This, and a further addition of 200,000 in 1792, together with 1 per cent. on all subsequent loans, were combined in one consolidated fund, to be applied continually at compound interest till the whole National Debt was paid off, which was calculated would be done in 45 years.

The Sinking Fund continued in full operation till 1813, when a change took place under the Chancellor of the Exchequer, Mr. Vansittart; from this period it continued to decline till 1838, when it was entirely abolished. The following fact will show, in a striking manner, the power of compound interest to refund, in a given time, any debt however great.

"A penny laid out at compound Interest at the birth of our Saviour would, in the year 1775, have amounted to a solid mass of gold eighteen times the whole weight of the globe."—Allison's History of Europe, vol. 6, page 158.

The question, to find the number of years that any principal would double itself at compound interest, is somewhat difficult, and requires for its solution the use of logarithms.

PROFIT AND LOSS.

Section 1.

(1) An article is bought at 1*s*. 5*d*. per unit, and sold at 1*s*. 7*d*.; find the gain per cent.

(2) An article is bought at 2*s*. 6*d*. per unit, and sold at 2*s*. 10*d*.; find the gain per cent.

(3) An article is bought at 5*s*. 9*d*. per unit, and sold at 5*s*. 6*d*.; find the loss per cent.

Section 2.

(4) An article is bought at 2*s*. 10*d*. per unit, and sold at 2*l*. 10*s*. 6*d*.; find the gain per cent.

(5) An article is bought at 1*l*. 11*s*. 4*d*. per unit, and sold at 1*l*. 12*s*. 8*d*.; find the gain per cent.

(6) An article is bought at 3*l*. 4*s*. 7½*d*. per unit, and sold at 3*l*. 14*s*. 8½*d*.; find the gain per cent.

Section 3.

(7) An article is bought at 1*l*. 2*s*. per unit, and sold at 1*l*. 3*s*. 6*d*.; find the gain per cent.

(8) An article is bought at 8*d*. per unit, and sold at 8½*d*.; find the gain per cent.

(9) An article is bought at 1*l*. 2*s*. per unit, and sold at 1*l*. 6*s*.; find the gain per cent.

(10) An article is bought at 7½*d*. per unit, and sold at 7*d*.; find the loss per cent.

Section 4.

(11) An article is bought at 2*l*. 10*s*. per unit, and sold at 2*l*. 15*s*.; find the gain per cent.

(12) An article is bought at 1*l*. 5*s*. per unit, and sold at 1*l*. 8s.; find the gain per cent.

(13) An article is bought at 3*s*. 6*d*. per unit, and sold at 3*s*. 8*d*.; find the gain per cent.

Section 5.

(14) An article is bought at 30*s*. per unit, and sold at 36*s*.; find the gain per cent.

(15) An article is bought at 1*l*, 3*s*. 6d. per unit, and sold at 1*l*. 5*s*. 6*d*.; find the gain per cent.

Section 5—(*continued.*)

(16) An article is bought at 3*l.* 6*s.* per unit, and sold at 3*l* 14*s.*; find the gain per cent.

(17) An article is bought at 4*l.* 18*s.* per unit, and sold at 5*l.* 10*s.*; find the gain per cent.

Section 6.

(18) An article is bought at 15*s.*; what is the selling price to gain 5 per cent.?

(19) An article is bought at 25*s.*; what is the selling price to gain 6 per cent.?

(20) An article is bought at 35*s.*; what is the selling price to gain 10 per cent.?

(21) An article is bought at 2*l.* 5*s.*; what is the selling price to gain 15 per cent.?

Section 7.

(22) An article is bought at 2*l.* 10*s.*; what is the selling price to gain 4⅛ per cent.?

(23) An article is bought at 3*l.* 15*s.*; what is the selling price to gain 5⅛ per cent.?

(24) An article is bought at 1*l.* 5*s.* 6*d.*; what is the selling price to gain 7 per cent.?

(55) An article is bought at 25*s.*, what is the selling price to gain 5⅛ per cent.?

Section 8.

(26) An article is bought at 18*s.*; what is the selling price to gain 4 per cent.?

(27) An article is bought at 18*s.* 6*d.*; what is the selling price to gain 3½ per cent.?

(28) An article is bought at 14*s.* 6*d.*; what is the selling price to gain 7 per cent.?

(29) An article is bought at 15*s.* 6*d.*; what is the selling price to gain 8 per cent.?

Section 9.

(30) An article is bought at 1*l.* 6*s.*; what is the selling price to gain 5½ per cent.?

(31) An article is bought at 2*l.* 2*s.* 6*d.*; what is the selling price to gain 4½ per cent.?

(32) An article is bought at 5*l.* 3*s.*; what is the selling price to gain 6 per cent.?

(33) An article is bought at 6*l.* 9*s.*; what is the selling price to gain 7 per cent.?

Section 10.

(34) An article is bought at 8*l.* 5*s.*; what is the selling price to gain 9 per cent.?

(35) An article is bought at 5*l.* 6*s.* 8*d.*; what is the selling price to gain 12 per cent.?

(36) An article is bought at 4*l.* 5*s.*; what is the selling price to gain 3½ per cent.?

(37) An article is bought at 5*l.* 4*s.*; what is the selling price to gain 5½ per cent.?

Section 11.

(38) Coals are bought at 24*s.*, and sold at 25*s.* 6*d.* per ton; how many tons must be sold per year to realize an income of 350*l.*?

(39) Cloth is bought at 1*l.* 14*s.* 6*d.*, and sold at 2*l.* 1*s.* 3*d.* per yard; what business must be done to realize an income of 257*l.*?

(40) Timber is bought at 2*s.* 1½*d.* per foot, and sold at 2*s.* 9½*d.*; how many feet must be sold to make a profit of 350*l.*?

Section 12.

(41) Coals are bought at 1*l.* 7*s.* 6*d.*, and sold at 1*l.* 6*s.* 6*d.* per ton; what is the loss per cent.? and what business will ruin a man possessing a fortune of 1500*l.*?

(42) Iron is bought at 12*l.* 16*s.* 6*d.*, and sold at 14*l.* 9*s.* 6*d.* per ton; required the gain per cent., and what business will realize an income of 500*l.*?

Section 13.

(43) Cloth sold at 15*s.* per yard; required the prime cost when the gain is 3 per cent.

(44) Coals are sold at 24*s.* per ton; required the prime cost when the gain is 6 per cent.

(45) Timber is sold at 2*s.* 4*d.* per foot; required the prime cost when the gain is 5 per cent.

Section 14.

(46) Iron is sold at 14*l.* per ton; required the prime cost when the gain is 5½ per cent.

(47) Tea is sold at 5*s.* 6*d.* per pound; required the prime cost when the gain is 4¼ per cent.

(48) Corn is sold at 14*l.* 10*s.* per load; required the prime cost when the gain is 3¾ per cent.

Section 15.

(49) Cloth is sold at 15*s.* per yard; required the prime cost when the gain is 5 per cent.

Section 15—(*continued*).

(50) Iron is sold at 12*l.* per ton; required the prime cost when the gain is 8 per cent.

(51) Copper is sold at 26*l.* per ton; required the prime cost when the gain is 14 per cent.

(52) Coals are sold at 22*s.* per ton; required the prime cost when the gain is 5½ per cent.

(53) Sugar is sold at 8½*d.* per pound, produces a profit of 3¼ per cent.; find the price of a cwt.

Section 16.

(54) Tea sold at 4*s.* 6*d.* per pound produces a profit of 4½ per cent.; find the price of a cwt.

(55) Timber sold at 2*s.* 4*d.* per foot produces a profit of 2½ per cent.; find the cost price.

(56) Wheat sold at 56*s.* per quarter, produces a profit of 5½ per cent.; find the cost price.

PRACTICE.

Section 1.

Find the value of

Find the value of

(1) 234 at 2*s.* 6*d.*

(2) 42 at 3*s.* 7*d.*

(3) 84 at 6*s.* 6*d.*

(4) 135 at 8*s.* 9*d.*

(5) 304 at 13*s.* 4*d.*

(6) 405 at 17*s.* 3*d.*

(7) 1856 at 18*s.* 7*d.*

Section 2.

(8) 1467 at 13*s.* 8*d.*

(9) 136 at 14*s.* 2*d.*

(10) 146 at 16*s.* 10*d.*

(11) [illegible]32 at 3*s.* 11*d.*

(12) 156 at 5*s.* 1*d.*

(13) 846 at 3*s.* 7*d.*

(14) 104 at 4*s.* 9*d.*

Section 3.

(15) 304 at 9½*d.*

(16) 506 at 2*s.* 6½*d.*

(17) 344 at 4*s.* 6¾*d.*

(18) 1001 at 10½*d.*

(19) 101 at 9¾d.

(20) 89 at 3¼*d.*

(21) 109 at 2½*d.*

Section 4.

(22) 1416 at 3*s.* 4¾*d.*

(23) 1346 at 17*s.* 6½*d.*

(24) 1567 at 13*s.* 4*d.*

(25) 1867 at 3*s.* 4*d.*

(26) 1460 at 6*s.* 8*d.*

(27) 3145 at 12*s.* 7½*d.*

(28) 146 at 1*s.* 1½*d.*

Section 5.

(29) 345 at 3*s.* 3½*d.*

(30) 156 at 2*l.* 3*s.* 4*d.*

(31) 1567 at 2*l.* 3*s.* 4*d.*

(32) 456 at 5*l.* 6*s.* 8*d.*

(33) 304 at 3*l.* 13*s.* 4*d.*

(34) 1506 at 4*l.* 17*s.* 6*d.*

(35) 145 at 6*l.* 15*s.* 8*d.*

Section 6.

(36) 136 at 3*l.* 6*s.* 8*d.*

(37) 1504 at 5*l.* 7*s.* 6*d.*

(38) 130 at 7*l.* 18*s.* 6*d.*

(39) 156 at 3*l.* 19*s.* 6*d.*

(40) 146 at 2*l.* 1*s.* 8*d.*

(41) 1367 at 4*l.* 7*s.* 8*d.*

Section 7.

Find the value of — Find the value of

(42) 376 at 2*l.* 3*s.* 7½*d.*

(43) 456 at 4*l.* 8*s.* 9½*d.*

(44) 376 at 2*l.* 12*s.* 6¾*d.*

(45) 456 at 3*l.* 17*s.* 6¾*d.*

Section 8.

(46) 567 at 1*l.* 17*s.* 7¾*d.*

(47) 843 at 4*l.* 14*s.* 5½*d.*

(48) 834 at 2*l.* 13*s.* 6½*d.*

(49) 567 at 21*l.* 14*s.* 6*d.*

Section 9.

(50) 8046 at 12*l.* 17*s.* 8¾*d.*

(51) 3046 at 17*l.* 18*s.* 9¾*d.*

(52) 3456 at 1*l.* 13*s.* 1½*d.*

(53) 1456 at 2*l.* 13*s.* 5½*d*

Section 10.

(54) 498 at 9¾*d.*

(55) 3467 at 1*s.* 6¾*d.*

(56) 467 at 3*s.* 4½*d.*

(57) 5670 at 8½*d.*

Section 11.

(58) 13678 at 1*l.* 2*s.* 6*d.*

(59) 1467 at 1*l.* 7*s.* 6*d.*

(60) 1567 at 8¾*d.*

(61) 1367 at 4¾*d.*

Section 12.

(62) 1560 at 5*s.* 7½*d.*

(63) 567 at 3*s.* 9½*d.*

(64) 1360 at 3*l.* 13*s.* 4*d.*

(65) 1467 at 2*l.* 17*s.* 6*d.*

Section 13.

(66) 567 at 10¾*d.*

(67) 137 at 11¾*d.*

(68) 1376 at 3*s.* 10½*d.*

(69) 1467 at 13*s.* 4½*d.*

Section 14.

(70) 126 at 6*l.* 15*s.* 6*d.*

(71) 867 at 5*l.* 18*s.* 6*d.*

(72) 3½ at 11*l.* 13*s.* 6*d.*

(73) 5¾ at 2*l.* 2*s.* 6*d.*

Section 15.

(74) 22⅛ at 15*s.* 6½*d.*

(75) $45\frac{5}{12}$ at 1*l.* 3*s.* 6*d.*

Section 16.

(76) 104¼ at 2*l.* 1*s.* 8*d.*

(77) $3046\frac{5}{12}$ at 3*l.* 3*s.* 4*d.*

Section 17.

(78) $4067\frac{5}{24}$ at 1*s.* 6½*d.*

(79) $3560\frac{18}{25}$ at 2*l.* 17*s.* 6*d.*

Section 18.

Find the value of　　Find the value of

(80) $806\frac{10}{13}$ at 4*l.* 3*s.* $6\frac{3}{4}$*d.*　(81) $5906\frac{3}{5}$ at 2*l.* 4*s.* 7*d.*

Section 19.

(82) $560\frac{7}{8}$ at $10\frac{3}{4}$*d.*　(83) $521\frac{5}{8}$ at 1*s.* $3\frac{1}{2}$*d.*

Section 20.

(84) $567\frac{12}{13}$ at 5*s.* $7\frac{1}{2}$*d.*　(85) $1809\frac{35}{48}$ at 1*l.* 6*s.* 8*d.*

Section 21.

(86) $467\frac{10}{11}$ at 3*l.* 4*s.* 6*d.*　(87) $3960\frac{11}{12}$ at 4*s.* $6\frac{1}{2}$*d.*

Section 22.

cwt. qr. lbs. £ s. d.　　cwt. qr. lbs. £ s. d.
(88) 27 1 14 at 3 4 6 per cwt.　(89) 54 1 7 at 5 16 7 per cwt.

Section 23.

cwt. qr. lbs. £ s. d.　　cwt. qr. lbs. £ s. d.
(90) 58 2 7 at 2 14 $7\frac{1}{2}$ per cwt.　(91) 45 3 21 at 1 6 $8\frac{1}{2}$ per cwt
(92) 104 2 7 at 2 7 $7\frac{1}{2}$ per cwt.

Section 24.

tons cwt. qr. £ s. d.　　tons cwt. qr. £ s. d.
(93) 24 10 3 at 5 6 8 per ton.　(94) 54 16 2 at 8 13 $4\frac{1}{2}$ per ton.
(95) 144 18 1 at 12 12 $8\frac{1}{4}$ per ton.　(96) 134 5 2 at 14 17 7 per ton.

Section 25.

tons cwt. qr. £ s. d.　　cwt. qr. lbs. £ s. d.
(97) 186 4 1 at 20 13 8 per ton.　(98) 19 3 11 at 4 11 9 per cwt.

cwt. qr. lbs. £ s. d.
(99) 9 3 10 at 1 18 9 per cwt.

oz. dwt. gr. £ s. d.
(100) 571 14 $16\frac{1}{2}$ at 3 11 $9\frac{1}{4}$ per oz.

s. d.
(101) The price of iron is 16 $7\frac{3}{4}$ per cwt., find the value of
tons cwt. qr. lbs.
24 15 2 14.

PROPORTIONAL PARTS.

To divide a given number into any number of parts which shall have to each other given ratios.

Rule.—Take the sum of the numbers forming the given ratios, for the denominators of fractions whose numerators are the respective ratios; multiply each of these fractions by the given number, and the products will be the parts required.

Example.—Divide 85 into three parts, which shall have to each other the ratios of 3, 5, 9.

$$\frac{3}{17} \times 85 = 15 \text{ first part.}$$

$$\frac{5}{17} \times 85 = 25 \text{ second part.}$$

$$\frac{9}{17} \times 85 = 45 \text{ third part.}$$

Section 1.

(1) Divide 190 into 4 parts in the ratios of 6, 9, 10, 13.

(2) Divide 216 into 4 parts in the ratios of 3, 5, 7, 9.

(3) Divide 369 into 3 parts in the ratios of 11, 13, 17.

Section 2.

(4) Divide 18840 into 5 parts in the ratios of 5, 9, 13, 15, 18.

(5) Divide 1575 into 5 parts in the ratios of 22, 27, 32, 42, 52.

(6) Divide 3475 into 5 parts in the ratios of 18, 19, 24, 28, 50.

Section 3.

(7) Divide 5504 into 3 parts in the ratios of 36, 54, 82.

(8) Divide 2807 into 3 parts in the ratios of 92, 105, 204.

(9) Divide 4824 into 3 parts in the ratios of 52, 64, 85.

Section 4.

(10) Divide 2144 into 6 parts in the ratios of 8, 9, 5, 7, 15, 23.

(11) Divide 4978 into 6 parts in the ratios of 25, 29, 39, 45, 52, 72.

(12) Divide 12552 into 6 parts in the ratios of 84, 87, 102, 504, 607, 708.

Section 5.

(13) Three workmen have 4*s.* 6*d.*, 4*s.* 0*d.*, 3*s.* 6*d.* per day, and they together earn 48*l.*, what is each man's share ?

(14) A, B, C enter into business with a capital of 450*l.*, 864*l.*, 985*l.* respectively ; the profits at the end of the year are 6897*l.*, what is each man's share ?

(15) Divide 423*l.* amongst 3 persons in the ratios of $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{5}$.

Section 6.

(16) Carbonic acid ($C\,O_2$) is composed of 2 parts of oxygen and 1 part carbon, the equivalents of oxygen and carbon being 8, 6, find the pure carbon and oxygen in 66 lbs. of carbonic acid.

(17) The equivalents of oxygen and sulphur are 8 and 16, find the pure oxygen and sulphur in 45 lbs. of sulphuric acid ($S\,O_3$).

(18) The equivalents of hydrogen and nitrogen are 1 and 14, find the pure hydrogen and nitrogen in 1 cwt. of ammonia ($H^3\,N$).

Section 7.

(19) The equivalents of oxygen and iron are 8, 28, find the pure oxygen and iron in 1 ton of protoxide of iron (Fe .O).

(20) Find the pure oxygen and iron in $\frac{1}{2}$ ton of black oxide of iron ($Fe._3\,O_4$).

(21) The equivalents of oxygen and copper are 8, 31.7, find the pure copper in 3 cwt. of protoxide of copper (Cu. O).

(22) Find the pure oxygen and copper in 4 cwt. of binoxide of copper ($Cu.\,O_3$).

Section 8.

(23) The equivalents of oxygen and lead are 8, 103.7, find the pure oxygen and lead in 19 lbs. of protoxide of lead, commonly called *litharge* (Pb. O).

(24) Gunpowder is composed of 75 parts nitre. 10 parts sulphur, 15 parts charcoal, how much nitre, sulphur, and charcoal will produce one ton of powder ?

(25) Bohemian glass is composed of 76 parts of silica, 15 parts of potash, 8 parts of lime, and 1 part of alumina, find the silica, potash, lime, and alumina required to make 3 cwt. of glass.

Section 9.

(26) Divide 55953*l.* amongst 4 persons in the ratios of $\frac{3}{7}$, $\frac{4}{9}$, $\frac{5}{11}$, $\frac{7}{13}$.

(27) The standard gold coin of England is composed of 22 parts of pure gold, and 2 parts alloy, what weight of gold is there in 6 sovereigns when $46\frac{29}{40}$ sovereigns weigh 1 lb. troy ?

(28) The daily wages of 3 men and 2 apprentices are 5*s.* 6*d.*, 5*s.* 3*d.*, 5*s.*, 2*s.* 6*d.*, and 2*s.* respectively, when at ordinary day work ; by working at task work for a week they earn 9*l.* 10*s.*, what is the share of each ?

Section 10.

(29) A, B, C engage in trade ; A's capital is 350*l.* for 4 months, B's capital is 576*l.* for 2 months, C's capital is 768*l*, for 6 months, at the end of which the whole profits amounted to 1007*l.*, required the share of each.

(30) Divide 814*l.* amongst 3 persons in the ratios of $\frac{2}{5}$, $\frac{3}{7}$. $\frac{5}{8}$.

(31) Divide 23678*l.* amongst 4 persons in the ratios of $\frac{5}{9}$, $\frac{6}{11}$, $\frac{7}{12}$, $\frac{8}{13}$.

Section 11.

(32) Divide 468*l.* into 4 parts, such that the second part shall be double the first, the third twice the first and second, and the fourth thrice the sum of the first, second, and third.

(33) Divide 1098*l.* amongst 3 persons in the ratios of $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{7}$.

SQUARE AND CUBE ROOTS.

Extract the Square Root of the following Numbers.

Section 1.

(1) 3844 (2) 5329 (3) 8100 (4) 13225 (5) 11664

Section 2.

(6) 7744 (7) 30976 (8) 39601 (9) 65025 (10) 962361

Section 3.

(11) 978121 (12) 1115136 (13) 1572516 (14) 2604996
(15) 4223025

Section 4.

(16) 5447556 (17) 8791225 (18) 8497225 (19) 8970025
(20) 8323225

Section 5.

(21) 13169641 (22) 25371369 (23) 25060036 (24) 40195600
(25) 69639025

Section 6.

(26) 18567481 (27) 29528356 (28) 41589601 (29) 53993104
(30) 76545001

Section 7.

(31) 34210801 (32) 44169316 (33) 56972304 (34) 66994225
(35) 93083904

Extract the Cube Root of the following Numbers.

Section 8.

(36) 438976 (37) 658503 (38) 274625 (39) 941192
(40) 1560896

Section 9.

(41) 4492125 (42) 248858189 (43) 525557943 (44) 389017000
(45) 502459875

Section 10.

(46) 517781627 (47) 693154125 (48) 991026973

Section 11.

(49) 1915864488 (50) 1995616979 (51) 2379270375

Section 12.

52) 8690991616 (53) 25803133875 (54) 26973008999

Section 13.

(55) 26865224875 (56) 100220636125 (57) 293681802023

Section 14.

(58) 396741328192 (59) 561107348992 (60) 982700724888

Extract the square and cube roots of the following numbers to four places of decimals.

Section 15.

(61) 6.573 (62) 18.91 (63) 30.97

Section 16.

(64) 559.4 (65) .0239 (66) 927.49

Section 17.

(67) 47.885 (68) 368.16 (69) 4.084

Section 18.

(70) .02351 (71) .004783

Section 19.

(72) $\frac{5}{4}$ (73) $\frac{3}{5}$.

Section 20.

(74) $\frac{7}{19}$ (75) $\frac{5}{13}$.

Section 21.

(76) $\frac{54}{7}$ (77) $\frac{13.148}{2.64}$.

Section 22.

(78) $\frac{1346}{145}$ (79) $\frac{5.66}{69.8}$.

Section 23.

(80) $\frac{2.88}{499.1}$ (81) $\frac{87.8}{1.792}$.

Section 24.

(82) $\frac{8.481}{3697}$ (83) $\frac{.7081}{44.7}$.

Section 25.

(84) $\frac{5}{12}$ (85) $\frac{14}{221}$.

Section 26.

(86) $\frac{3}{5}$ (87) $\frac{1}{151}$

Section 27.

(88) $\frac{1}{1823}$ (89) $\frac{1.41968}{.467}$.

Section 28.

(90) $\frac{3}{14}$ (91) $1\frac{5}{7}$.

DUODECIMALS
OR CROSS MULTIPLICATION.

Section 1.

Find the value of

	ft.	in.	sec.		ft.	in.	sec.		ft.	in.	sec.		ft.	in.	sec.
(1)	5	6	0	×	3	4	0	(2)	8	7	0	×	8	4	0
(3)	12	10	0	×	7	7	0	(4)	13	6	0	×	8	5	0

Section 2.

(5)	183	3	0	×	12	2	0	(6)	83	9	0	×	24	11	0
(7)	54	5	6	×	32	4	0	(8)	84	7	11	×	15	7	0

Section 3.

(9)	15	4	7	×	16	5	0	(10)	18	7	6	×	24	5	7
(11)	34	5	7	×	33	7	9	(12)	44	3	11	×	55	5	7

Section 4.

(13)	87	5	7	×	31	7	8	(14)	445	7	8	×	55	3	7
(15)	834	7	9	×	34	7	11								

Section 5.

(16)	567	7	5	×	15	7	8	(17)	56	3	5	×	18	3	5
(18)	56	11	5	×	52	7	8								

Section 6.

(19)	84	5	7	×	84	5	3	(20)	54	6	3	×	13	8	9
(21)	57	5	8	×	15	7	8								

Section 7.

(22)	84	8	7	×	57	5	8	(23)	144	3	1	×	83	7	5
(24)	85	5	7	×	16	5	3								

Section 8.

(25)	99	9	9	×	17	11	5	(26)	342	7	8	×	54	8	9
(27)	567	11	5	×	59	3	7								

Section 9.

(28) The length, breadth, and height of a room are 26 ft. 3 in. 4 sec. 23 ft. 4 in. 7 sec.; and 15 ft. 3 in. 9 sec.; what will be the cost of papering the four walls at 1*s.* 3½*d.* per square foot? and how much will the carpet cost at 1*s.* 4½*d.* per square foot?

Section 10.

(29) A window is 8 ft. 3 in. 5 sec. high, and 3 ft. 4 in. 7 sec. wide, what will 7 such windows cost glazing at 1*s.* 6½*d.* per foot?

(30) What is the cost of flooring a room 28 ft. 3 in. 9 sec. long, 17 ft. 4 in. 7 sec. wide at 1*s.* 4*d.* per square foot?

Section 11.

(31) What will the paving of a street cost 900 ft. 5 in. 4 sec. long, 26 ft. 4 in. 9 sec. wide, at 3*s.* 6¾*d.* per square yard?

(32) What will be the expense of plastering the ceiling of a room 26 ft. 7 in. 5 sec. long, 16 ft. 4 in. 10 sec. wide, at 1½*d.* per square foot?

Section 12.

(33) A rectangular box is 3 ft. 5 in. 4 sec. long, 2 ft. 3 in. 5 sec. broad, and 1 ft. 3 in. 7 sec. deep, find the value of the timber which it contains, at 1*s.* 3½*d.* per square foot.

(34) Find the cost of painting the walls of a room 22 ft. 4 in. 7 sec. long, 15 ft. 3 in 7 sec. wide, and 13 ft. 7 in. 8 sec. high, at 1*s.* 1½*d.* per square yard.

Section 13.

(35) Find the expense of glazing 10 windows, 4 of which are 3 ft. 4 in. 11 sec. by 7 ft. 3 in. 8 sec. 3 of which are 3 ft. 1 in. 5 sec. by 8 ft. 4 in. 7 sec., and the remaining 3 are 2 ft. 11 in. 9 sec. by 6 ft. 7 in. 9 sec., at 3*s.* 7½*d.* per foot.

Section 14.

(36) What will a rectangular cistern 24 ft. 3 in. 7 min. by 15 ft. 4 in. 7 sec. by 4 ft. 7 in. 8 sec. cost lining the sides, ends, and bottom with lead at 1*s.* 3¼*d.* per square foot?

(37) Find the cost of paving a floor 213 ft. 4 in. 7 sec. long, and 18 ft. 4 in. wide at 6*s.* 4½*d.* per square yard.

MISCELLANEOUS EXAMPLES.

Section 1.

(1) Find the value of $\frac{5\frac{1}{2} - 3\frac{1}{6}}{2\frac{1}{3} - 1\frac{1}{6}} \times \frac{2\frac{1}{2}}{4\frac{1}{4}} \div \frac{1\frac{1}{6}}{2\frac{1}{6}}.$

(2) Find the value of $\frac{6}{7}$ of $\frac{7}{12}$ of $\frac{2\frac{1}{2}}{3\frac{1}{4}}$ of 17*s.* 6½*d.*

(3) Reduce 3*l.* 18*s.* 7½*d.* to the fraction of 24*s.*

(4) Divide .80514 by .00567.

(5) Find the value of1.346 of ⅝ of a guinea.

(6) Reduce 2*l.* 13*s.* 6*d.* to the decimal of a pound.

(7) If 7 men can mow a field containing 4½ acres in 8⅓ days, in how many days will 34 men mow a field containing 7⅓ a. ?

(8) Find the value of 367½ yards of cloth at 2*l.* 3*s.* 7¾*d.* per yard.

(9) Find the amount of 8340*l.* 17*s.* 8½*d.* for 3½ years at 2½ per cent. per annum.

(10) Cloth is bought at 1*l.* 13*s.* 4*d.* per yard, what is the selling price to gain 7½ per cent. ?

(11) Divide 55*l.* 13*s.* 1½*d.* amongst 3 men in the ratios of ½, ⅓, ¼.

(12) Extract the square root of 5659641.

(13) Extract the cube root of 23862997439.

(14) A and B together can do a piece of work in 18 days, which B can do in 32 days, in what time can A do it alone ?

(15) Find the cost of papering a room 16 ft. 3 in. 4 sec. long, 15 ft. 9 in. 10 sec. wide, 11 ft. 3 in. 7 sec. high, at 14½*d.* per square foot.

(16) Which is the most advantageous to invest 1000*l.*, the 3½ per cents. at 78, or the 4¼ per cents. at 86 ?

(17) In 3½ years, 356*l.* 7*s.* 8*d.* amounts to 412*l.* 10*s.* $3\frac{22}{100}$*d.*, find the rate per cent. per annum.

Section 2.

(1) Find the value of $\frac{3\frac{1}{4} - 2\frac{1}{2}}{1\frac{1}{3} - \frac{1}{18}} \times \frac{1\frac{1}{2}}{3\frac{1}{3}} \div \frac{3\frac{1}{2}}{4\frac{1}{18}} \times \frac{119}{192} \div \frac{4}{5}.$

(2) Reduce ¾ of ⅚ of ⅘ of 3*s.* 6¾*d.* to the fraction of a pound.

(3) Divide 1.46638 by .00467.

(4) Find the value of ⅔ of ⅚ of 1.3467 of 3*l.* 10*s.*

(5) Reduce 3 yards 2 feet 4½ inches to the decimal of a yard.

Section 2—(*continued*)

(6) If 12 oxen eat $1\frac{1}{2}$ acres of grass in $12\frac{1}{4}$ days, how long will 49 oxen be in eating $13\frac{1}{2}$ acres ?

(7) What principal will produce an interest of 137*l.* in $2\frac{1}{2}$ years, at 5 per cent. ?

(8) Divide 1337*l.* amongst 3 persons in the ratios of $\frac{1}{7}$, $\frac{1}{8}$, $\frac{1}{9}$.

(9) A person invested 1000*l.* in the $3\frac{1}{2}$ per cent. consols at 94*l.*, and sold at 96*l.*, what did he gain ?

(10) Extract the cube root of 842837448536.

(11) If A and B together can do a piece of work in 20 days, which A can do in 27 days, in what time can B alone do it ?

(12) Find the cost of a chest whose dimensions are 3 ft. 4 ins. 7 secs. long, 2 ft. 7 ins. 8 secs. wide, and 1 ft. 6 in. 7 secs. high, at $7\frac{3}{4}$*d.* per square foot.

(13) Find the brokerage on a money transaction of 5378*l.* 17*s.* 8*d.* at $\frac{3}{8}$ per cent.

(14) In $4\frac{1}{2}$ years 530*l.* amounts to 643*l.* 5*s.* 9*d.*, find the rate per cent. per annum.

Section 3.

(1) If 5 men earn 7*l.* 10*s.* per week, how much will 30 men earn in 6 weeks ?

(2) If 120 men can build a gun boat in 160 days of 8 hours long, how many hours a day ought 540 men to work in order to build 9 such boats in 480 days ?

(3) How many hours a day must 56 men work to build $\frac{4}{5}$ of a ship in $150\frac{1}{2}$ days, when 120 men can build $\frac{3}{7}$ of the ship in $30\frac{3}{4}$ days of $9\frac{3}{5}$ hours each ?

(4) Find the value of $\dfrac{2\frac{1}{5} + 3\frac{1}{8} - 5\frac{3}{80}}{7\frac{1}{4} - 6\frac{3}{8} + 1\frac{11}{24} - 1\frac{1}{48}} \div \dfrac{3\frac{1}{2} - 3\frac{1}{8}}{3\frac{1}{2} + 3\frac{3}{8}}$.

(5) What part of a guinea is $\frac{2}{3}$ of $\frac{1}{2}$ of 1*l.* ?

(6) Divide ·00037568 by 87·6954.

(7) What is the rate of interest so that 520*l.* 10*s.* 6*d.* may produce 18*l.* 18*s.* in 4 years ?

(8) Extract the square root of $\frac{1}{3}$ to four places of decimals.

(9) Extract the cube root of $\frac{1}{3}$ to four places of decimals.

(10) Divide 627*l.* equitably amongst 4 persons, in the ratios of 3, 4, 5, 6.

(11) Bought sugar at 8*d.* per pound, find the selling price to gain $5\frac{1}{2}$ per cent.

(12) Find the cost of 34 tons 1 qr. 14 lbs. of iron, at 12*l.* 14*s.* $6\frac{1}{2}$*d.* per ton.

(13) A can do a piece of work in 26 days, which B can do in 32 days, they work together 4 days, then A leaves off, in what time will B finish it?

(14) Two sawyers cut a balk of timber 7 times in the direction of its length and height, which are 25 feet 3 inches 7 sec. and 2 ft. 5 in. 9 sec. respectively, what do they earn at 1½*d.* per square foot?

(15) A person has 3400*l.* of 3½ per cent. Stock worth 77⅛, he sells out, and buys in the 5 per cents. at 106, how is his income affected?

(16) In 5¾ years 1000*l.* amounts to 1215*l.* 12*s.* 6*d.* find the rate per cent. per annum.

Section 4.

(1) Find the value of $\frac{2\frac{1}{4} - 1\frac{1}{4}}{5\frac{1}{3} - 2\frac{1}{3}} \times \frac{3\frac{1}{3}}{4\frac{1}{4}} \div \frac{9}{17}$ of 1*l.* 3*s.* 6*d.*

(2) Reduce 3*s.* 7¾*d.* to the fraction of 4*s.* 7½*d.*

(3) Divide ·62578 by ·00467.

(4) Reduce 2 ft. 7⅓ in. to the decimal of 3½ yards.

(5) Find the value of ¾ of 2·1467 tons.

(6) If 17 men can do a piece of work in 9½ days, in how many days will 823 men do 4⅓ times the work?

(7) Find the interest of 5678*l.* 3*s.* 7½*d.* for 4 years, at 5½ per cent. per annum.

(8) Extract the square root of $\frac{3}{14}$, and the cube root of $\frac{5}{17}$, to 4 decimal places.

(9) Timber is sold at 3½*d.* per square foot, what is the prime cost when the gain is 7⅛ per cent?

(10) Divide 7516 equitably amongst 10 apprentices at 3*s.* per week, 132 men at 24*s.* per week, and 7 officers at 4*l.* per week.

(11) A, B, C, together can do a piece of work in 12 days, which can be done by B and C together in 18 days, and by A and C together in 20 days, in what time can each do it?

(12) Find the cost of painting the walls of a room whose length, breadth, and height are 18 ft. 5 in. 9 sec., 15 ft. 7 in. 8 sec., 12 ft. 4 in. 6 sec., at 4¾*d.* per square yard.

(13) A person has 2340*l.* of 4½ per cents. Stock at 88⅛, how will his income be affected by selling out and purchasing 3 per cent. Stock at 76⅛?

(14) In 7¾ years 2000*l.* amounts to 2426*l.* 5*s.*; find the rate per cent. per annum.

Section 5.

(1) Find the value of $\frac{\frac{1}{2}+\frac{1}{3}+\frac{1}{4}+\frac{1}{5}}{\frac{1}{2}-\frac{1}{3}-\frac{1}{4}+\frac{1}{5}}+\frac{2\frac{1}{2}-1\frac{1}{3}}{5\frac{1}{2}-2\frac{1}{3}}\times\frac{3\frac{1}{2}}{1\frac{1}{4}}$

(2) Find the value of $\frac{5}{7}$ of $\frac{7}{15}$ of $\frac{3}{4}-\frac{6}{13}$ of $\frac{13}{36}$.

(3) Find the value of $\frac{3}{7}$ of $\frac{14}{6}$ of $5\frac{1}{2}$ of $1\frac{1}{3}$ ton.

(4) Reduce $\frac{3\frac{1}{4}}{2\frac{1}{3}}$ to a decimal.

(5) Find the value of $\frac{2\cdot2836}{\cdot0173}-\frac{\cdot0019278}{\cdot00567}-\frac{\cdot03848}{\cdot74}$

(6) Find the value of $\frac{1}{3}$ of $\frac{9}{13}$ of 1·3456 tons.

(7) Reduce 3 tons 3 cwt. 56 lbs. 13 oz. to the decimal of a ton.

(8) If the 4½*d.* loaf weigh 1lb. 6½ oz., when flour is 3*s.* 9*d.* a peck: what will the 19*d.* loaf weigh when flour is 14*s.* 3*d.* per bushel ?

(9) What principal will give an interest of 132*l.* in 3½ years, at 4 per cent. per annum.

(10) What is the brokerage on a sale of 5673*l.* 18*s.* 9½*d.*, at 3½*d.* per cent ?

(11) In which is it most advantageous to invest; the 5 per cents. at 104¼, or the 4 per cents. at 97½ ?

(12) Find the value of 314¾ at 3*l.* 7*s.* 6½*d.*

(13) Extract the square root of $\frac{5}{13}$ to 5 places of decimals.

(14) Extract the cube root of $\frac{1\cdot45}{2\frac{1}{4}}$ to five places of decimals.

(15) Coals are bought at 24*s.* per ton ; what is the selling price to gain 8½ per cent ? and how many tons must be sold to realise an income of 355*l.* per annum ?

(16) A, B, C, and D enter into business ; A's capital was 350*l.* for 5 months, B's capital was 456*l.* for 4 months, C's capital was 855*l.* for 9 months, D's capital was 1040*l.* for 10 months, when the whole profits amounted to 3467*l.* : required each man's share.

(17) Find the amount of 567*l.* 10*s.* 6*d.* for 3 years at 4 per cent. per annum, compound interest.

(18) Find the value of 114 ft. 5 ins. 6 sec. × 84 ft. 5 ins. 10 sec.

(19) 24 shipwrights can do a piece of work in 8 days which 32 labourers can do in 12 days ; in what time will 7 shipwrights and 10 labourers do it ?

Section 6.

(1) Find the value of $\left(\frac{5\frac{1}{4}}{3\frac{1}{4}} - \frac{7\frac{1}{6}}{9\frac{1}{6}} - \frac{249}{299} + \frac{2\frac{1}{7}}{3\frac{1}{7}}\right) + \frac{5}{11} \times \frac{2}{3}$

(2) Find the value of $\frac{7}{11}$ of $\frac{22}{28}$ of $\frac{4}{9}$ of $\frac{7}{12}$ of $1\frac{1}{3}$ tons.

(3) Reduce 3 cwt. 2 qrs. 3 lbs. 4 oz. $11\frac{5}{17}$ drs. to the fraction of a ton.

(4) Reduce $\frac{5\frac{1}{2}}{6\frac{1}{4}} - \frac{3\frac{1}{6}}{4\frac{1}{6}} + \frac{3}{8}$ to a decimal.

(5) Find the value of $\frac{\cdot015525}{\cdot345} - \frac{\cdot002408}{\cdot56} + \frac{\cdot1664}{\cdot032}$

(6) Reduce 2 a. 3 r. $21\frac{1}{3}$ p. to the decimal of $5\frac{1}{8}$ acres.

(7) Reduce 6 cwt. 3 qrs. 16 lbs. 12 ozs. $12\frac{4}{5}$ drs. to the decimal of a ton.

(8) If a man travels $345\frac{4}{5}$ miles in $8\frac{4}{5}$ days of $10\frac{1}{3}$ hours long, in what time will he travel 1729 miles when the days are $9\frac{1}{3}$ hours long ?

(9) In what time will a sum of money triple itself at $3\frac{1}{2}$ per cent. per annum ?

(10) Find the value of 5 tons 13 cwt. 2 qrs. 14 lbs. at 4*l.* 8*s.* $9\frac{3}{4}$*d.* per cwt.

(11) Find the value of $\sqrt[3]{\frac{3}{4} - \frac{1}{9}}$ to five places of decimals.

(12) Find the value of $\sqrt[3]{5\frac{1}{6} - 2\frac{1}{12}}$ to five places of decimals.

(13) Coals are sold at 23*s.* per ton ; required the prime cost to gain $7\frac{1}{2}$ per cent.

(14) Divide 6444*l.* amongst 3 persons in the ratios of $1\frac{1}{3}$, $2\frac{1}{2}$, $3\frac{1}{2}$.

(15) Find the amount of 1000*l.* for 5 years at $3\frac{1}{2}$ per cent. per annum compound interest.

(16) What will be the cost of papering a room 23 ft. 7 in. 5 sec. long, 17 ft. 8 ins. 11 sec. wide, 13 ft. 5 ins. 3 sec. high, at $4\frac{1}{2}$*d.* per square foot.

(17) Find the difference in income by transferring 3400*l* stock from the $4\frac{1}{2}$ per cents. at 92, to the $5\frac{1}{2}$ per cents at 97.

(18) 18 shipwrights can do a piece of work in 5 days, which can be done by 12 labourers in 9 days, and 24 apprentices in 16 days ; in what time will 3 shipwrights, 5 labourers, and 8 apprentices do it ?

Section 7.

(1) Find the value of $\frac{3\frac{1}{2} + 4\frac{1}{4} - 3\frac{1}{8}}{5\frac{1}{6} - 2\frac{1}{12} - 1\frac{1}{24}} \times \frac{7\frac{1}{2}}{8\frac{1}{4}} \div \frac{53}{7} \times \frac{33}{15}$

Section 7—(*continued*).

(2) Reduce 1*l.* 3*s.* 9½*d.* to the fraction of a guinea.

(3) Find the value of $\frac{3}{8}$ of $\frac{4}{7}$ of $\frac{8}{15}$ of $\frac{3\frac{1}{2} - 1\frac{1}{4}}{5\frac{1}{8} - 2\frac{3}{8}}$ of a guinea.

(4) Reduce $\frac{8\frac{1}{4}}{7\frac{1}{8}} + \frac{6\frac{1}{8}}{9\frac{1}{7}} + \frac{3}{\frac{4}{5}}$ to a decimal.

(5) Find the value of

$$\frac{\cdot 00110944}{\cdot 3467} + \frac{\cdot 00324756}{\cdot 873} - \frac{\cdot 1455489}{56 \cdot 7} - \frac{\cdot 27255}{79}$$

(6) Find the value of 5·678 × 2½ guineas.

(7) Reduce 2*l.* 7*s.* 8¾*d.* to the decimal of 24 shillings.

(8) Find the value of 347⅓ lbs. of tea at 3*s.* 9¾*d.* per lb.

(9) Extract the square and cube roots of 1⅝ to 4 decimal places.

(10) Find the interest of 5678*l.* 17*s.* 8¾*d.* for 3½ years at 4¼ per cent. per annum.

(11) If the 6½*d.* loaf weigh 2 lbs. 3 oz. when flour is 3*s.* 2½*d.* per stone, what will be the weight of a 10½*d.* loaf when flour is 4*s.* 7½*d.* per stone ?

(12) In what time will a sum of money triple itself at 4¾ per cent. per annum ?

(13) What principal will gain 52*l.* 3*s.* 4*d.* in 3½ years at 4½ per cent. per annum ?

(14) Three men, A, B, C, have 3*s.* 6*d.*, 4*s.* 4*d.*. 5*s.* 3*d.* per day respectively, when working at day-work ; they work at a bargain during one week, and earn 6*l.* 15*s.* 6*d.* what is each man's share ?

(15) Coals are bought at 26*s.* 6*d.* per ton, and sold at 28*s.* 9*d.* ; find the gain per cent., and how many tons yearly must be sold to realise an income of 450*l.* ?

(16) Find the amount of 345*l.* for 3½ years at 3 per cent. per annum compound interest.

(17) A cistern can be filled by three pipes, A, B, C, in 2, 3, and 4 hours respectively ; they all run together for 10 minutes, after which A is stopped ; in what time will B and C fill the remainder of the cistern ?

(18) Transfer 4000*l.* stock from the 3½ per cents. at 86, to 4½ per cents. at 94, and find the difference in the income.

(19) What will be the cost of 34 feet 5 in. 7 sec. of paper 3 feet 8 in. 4 sec. wide, at 8¾d. per square foot ?

(20) If A and B can do a piece of work in 10½ days, which can be done by A and C in 12⅓ days, and by B and C in 14¼ days ; in what time can each do it alone ?

Section 8.

(1) Find the value of $\frac{3\frac{1}{4}}{5\frac{1}{3}} \div \frac{5\frac{1}{7}}{8\frac{1}{14}} \times \frac{18}{26} + \frac{113}{11.}$

(2) Reduce 2 tons 2 cwt. 1 qr. 11 lbs. $8\frac{8}{17}$ oz. to the fraction of a ton.

(3) Find the value of $\frac{1}{\frac{3}{8}} \div \frac{15}{17} \times \frac{9}{34} \div \frac{5\frac{1}{7}}{11\frac{1}{14}}$ of a ton.

(4) Reduce $\frac{3\frac{1}{4} - 2\frac{1}{3}}{5\frac{1}{4} - 2\frac{1}{18}} \div \frac{2\frac{1}{3}}{3\frac{1}{10}} \times \frac{51}{31}$ to a decimal fraction.

(5) Find the value of

$$.42 \times .00437 + \frac{\cdot 357732}{\cdot 684} - \frac{\cdot 0004088}{\cdot 584}$$

(6) Find the value of $\left(\frac{2\frac{1}{2}}{3\frac{1}{4}} \div 2.314\right)$ of $1\frac{1}{3}$ ton.

(7) Reduce 2 m. 7 f. 18 p. 3 yds. to the decimal of 2 miles.

(8) Find the value of $576\frac{3}{8}$ cwt. of iron at 3*l.* 7*s.* $10\frac{1}{4}$*d.* per cwt.

(9) Extract the square and cube roots of $54\frac{3}{8}$ to four decimal places.

(10) Find the amount of 374*l.* 18*s.* $7\frac{1}{2}$*d.* for $4\frac{1}{2}$ years at $3\frac{1}{4}$ per cent. per annum.

(11) If 40342 cubic feet of gas be consumed in 3 m. 3 w. by 16 burners which burn $3\frac{1}{7}$ hours per day, in how many months will 24 burners, which burn $8\frac{1}{3}$ hours per day, consume 56784 cubic feet of gas ?

(12) What principal will produce an interest of 234*l.* 13*s.* 4*d.* in $7\frac{1}{2}$ years at $2\frac{3}{4}$ per cent. per annum ?

(13) In what time will a principal of 1562*l.* 17*s.* 6*d.* amount to 2027*l.* 16*s.* $7\frac{3}{20}$*d.* at $3\frac{1}{2}$ per cent. per annum ?

(14) Divide 5678*l.* 15*s.* 9*d.* amongst A, B, and C in the ratios of $2\frac{1}{2}$, $3\frac{1}{3}$, $4\frac{1}{4}$.

(15) Cloth is bought at 17*s.* 6*d.* per yard, required the selling price to gain $5\frac{3}{4}$ per cent.

(16) Find the amount of 567*l.* for $4\frac{1}{2}$ years at 4 per cent, per annum, compound interest.

(17) A, B, C can do a piece of work in 25, 35, 45 days respectively; they all work together for 3 days, in what time will B and C finish the remainder ?

(18) Transfer 5400*l.* stock from the $4\frac{1}{2}$ per cents. at 98, to 5 per cents. at 104, and find the difference in the income.

(19) Find the value of a plot of land 67 ft. 3 in. 4 sec. by 14 ft. 5 ins. 6 sec. at 5*s.* $6\frac{1}{2}$*d.* per foot.

Section 9.

(1) Find the value of $\dfrac{5 - 3 + 4 - 2}{\dfrac{5\frac{1}{2} - 3\frac{1}{4}}{6}} \times \dfrac{5}{16} \div \dfrac{5}{12}.$

(2) What part of an acre is 1 a. 1 r. 30 p. $33\frac{11}{18}$ yds. ?

(3) Find the value of $\left(\dfrac{3}{\frac{5}{7}} + \dfrac{3}{4}\right) \times \dfrac{10}{11} \div \dfrac{15}{8}$ of an acre.

(4) Reduce $\dfrac{3\frac{1}{4}}{6\frac{1}{8}} - \dfrac{2}{5} + \dfrac{3\frac{1}{4} - 1\frac{1}{2}}{5\frac{1}{2} - 3\frac{1}{4}}$ to a decimal.

(5) Find the value of $5.634 \times .0057 + \dfrac{4.2325}{8465} \div \dfrac{.39424}{5632}$

(6) Find the value of $\left(\dfrac{5\frac{1}{4}}{\frac{1}{2}} + \dfrac{3}{4}\right)$ of .0467 of $\frac{3}{4}$ of an acre.

(7) Reduce 5 b. 1 r. 15 qu. 21 s. of paper to the decimal of 18 bundles.

(8) Find the value of 53 tons 14 cwt. 3 qrs. 21 lbs. at 13*l.* 14*s.* $6\frac{1}{2}$*d.* per cwt.

(9) Extract the square and cube roots of .0467 to four places of decimals.

(10) In what time will 450*l.* gain an interest of 75*l.* at $2\frac{3}{4}$ per cent. per annum ?

(11) If 18 men can do a piece of work in $3\frac{1}{2}$ months, working $27\frac{1}{4}$. days per month, in what time will 91 men do $3\frac{1}{4}$ times the work, by working $31\frac{1}{2}$ days per month ?

(12) What principal will produce an interest of 135*l.* 3*s.* 4*d.* in $4\frac{1}{2}$ years at $3\frac{1}{2}$ per cent. per annum ?

(13) In what time will a principal of 563*l.* 12*s.* amount to 644*l.* 19*s.* $4\frac{16}{25}$*d.* at $2\frac{3}{4}$ per cent. per annum ?

(14) Divide 26,021*l.* 5*s.* equitably amongst 5 captains, 15 inferior officers, and 1300 men ; a captain having 55*l.*, an inferior officer 22*l.*, and a man 2*l.* 10*s.* per month.

(15) Find the amount of 2000*l.* for 5 years at 2 per cent. per annum, at compound interest.

(16) Corn is sold at 13*l.* 15*s.* per load, required the prime cost when the gain is $6\frac{1}{4}$ per cent.

(17) A and B can do a piece of work in 7 days, which can be done by A and C in 10, and by B and C in 12 days, in what time will each do it ?

(18) Which is the most advantageous to invest, $3\frac{1}{2}$ per cent. at 86, or $4\frac{1}{2}$ per cent. at 94 ?

(19) Find the value of a plot of land 132 ft. 5 ins. 10 sec. by 42 ft, 7 ins. 9 sec. at 7*s.* $9\frac{1}{2}$*d.* per square foot.

Section 10.

(1) Find the value of $\frac{1}{\frac{4}{7}} \times \frac{\frac{3}{4}}{5} \div \frac{7}{15} \times \frac{5}{3} \div \frac{6}{5}$

(2) What part of a pound Troy is 8 oz. $3\frac{23}{35}$ drs. avoirdupois?

(3) Find the value of $(\frac{3}{4} + \frac{5}{6} - \frac{15}{16})$ of $\frac{9}{14}$ of $\frac{21}{18}$ of $3\frac{1}{2}$ lbs. troy.

(4) Reduce $\frac{3\frac{1}{2}}{4\frac{1}{10}} - \frac{5\frac{1}{3}}{10\frac{1}{6}} + \frac{5\frac{1}{7} - 3\frac{1}{14}}{7\frac{1}{14} - 5\frac{2}{7}}$ to a decimal fraction.

(5) Find the value of $346 \times \cdot0035 - \frac{\cdot01384}{346} - \frac{\cdot2672}{835}$.

(6) Find the value of $\left(\frac{1}{\frac{5}{8}} \div \frac{6}{15}\right)$ of $\cdot1345$ lbs. troy.

(7) Reduce 8 months 3 weeks 6 days 20 hours $59\frac{1}{3}$ min. to the decimal of a month.

(8) Find the value of 133 acres 2 roods 20 poles of land, at 35*l.* 17*s.* $9\frac{1}{4}$*d.* per rood.

(9) Extract the square and cube roots of 8·4678 to four places of decimals.

(10) A principal of 1600*l.* will give an interest of 166*l.* in $4\frac{1}{2}$ years; find the rate per cent.

(11) If 204 men can build $\frac{3}{8}$ of a ship in 384 days, working $10\frac{1}{3}$ hours per day, in what time will 768 men build $\frac{5}{8}$ of it, by working $8\frac{1}{2}$ hours per day ?

(12) In what time will 3450*l.* 4*s.* $6\frac{1}{2}$*d.* amount to 4515*l.* 9*s.* $8\frac{1}{4}$*d.* at $4\frac{3}{4}$ per cent. per annum?

(13) What principal will gain 132*l.* 5*s.* in 5 years, at $4\frac{3}{4}$ per cent. per annum?

(14) Shipwrights and shipwright apprentices have 4*s.* 6*d.* and 1*s.* 6*d.* per day, respectively; divide 4332*l.* equitably amongst 84 men and 52 apprentices.

(15) Find the amount of 3540*l.* 5*s.* for $3\frac{1}{2}$ years, at 5 per cent. per annum compound interest.

(16) Bought iron at 14*l.* 15*s.* per ton, how must it be sold to gain $7\frac{3}{4}$ per cent.

(17) If 12 shipwrights or 16 labourers can do a piece of work in 46 days, in what time will 7 shipwrights and 11 labourers finish a similar piece of work?

(18) What is the cost of 550*l.* in the 3 per cent. Consols at $82\frac{5}{8}$, allowing $\frac{1}{8}$ per cent. for brokerage?

Section 10—(*continued*).

(19) Find the cost of planking the floor of a room 521 ft. 7 in. 11 sec. by 24 ft. 3 in. 7 sec., at 9¾*d.* per square foot.

QUESTIONS IN SECTION 10, MISCELLANEOUS EXAMPLES, WORKED AT FULL LENGTH.

Question 1.

$$\frac{1}{\frac{5}{7}} \times \frac{\frac{3}{4}}{5} \div \frac{7}{15} \times \frac{5}{3} \div \frac{6}{5} = \frac{\cancel{7}}{\cancel{5}} \times \underset{4}{\frac{\cancel{3}}{\cancel{20}}} \times \overset{3}{\frac{\cancel{15}}{\cancel{7}}} \times \frac{\cancel{5}}{\cancel{3}} \times \underset{2}{\frac{5}{\cancel{6}}} = \frac{5}{8}\ \textit{Ans.}$$

In forms of $\left(\frac{1}{\frac{5}{7}}\right)$ particular attention is required to distinguish the numerator—properly speaking—from the denominator. A strong line is generally adopted to separate the numerator and denominator in these compound fractions.

Thus, $\frac{1}{\frac{5}{7}}$ is different from $\frac{\frac{1}{5}}{7}$; the first is $\frac{7}{5}$, meaning one divided by $\frac{5}{7}$; and the second is $\frac{1}{35}$, meaning $\frac{1}{5}$ divided by 7.

Question 2.

Observe, that 5760 grains make a ℔. troy, and 7000 grains make a ℔. avoirdupois.

$$\overset{\text{oz.}}{8}\ \overset{\text{dr.}}{3\frac{23}{35}} = \overset{\text{oz.}}{8}\ \overset{\text{dr.}}{\frac{128}{35}} = \overset{\text{oz.}}{8\frac{8}{35}} = \overset{\text{oz.}}{\frac{238}{35}} = \frac{18}{35} \text{ pounds avoirdupois.}$$

$$\therefore\ \frac{18}{35} \times 7000 = 3600 \text{ grains in } \frac{18}{35} \text{ pounds avoirdupois.}$$

And 5760 = grains in a pound troy.

Therefore, $\frac{3600}{5760} = \frac{5}{8}$ of a pound troy.—*Ans.*

Question 3.

Wherever there are several fractions to be added or subtracted, they must be reduced to a simple fraction, and the result must be operated on as directed by the signs placed between each fraction. Wherever *of* is used, the sign of multiplication must be written in its place.

Question 3—(*continued*).

$(\frac{3}{4}+\frac{5}{6}-\frac{15}{12})$ of $\frac{9}{14}$ of $\frac{21}{18}$ of $3\frac{1}{2}$ lbs. troy $=(\frac{9}{12}+\frac{10}{12}-\frac{15}{12})\times\frac{9}{14}\times\frac{21}{18}\times\frac{7}{2}$ lbs. troy

$$\begin{array}{l} 8)\;7\quad(0 \text{ lbs.} \\ \;\;\;\;12 \\ \hline 8)\;84\;(10 \text{ oz.} \\ \;\;\;\;80 \\ \hline \;\;\;\;\;4 \\ \;\;\;\;20 \\ \hline 8)\;80\;(10 \text{ dwts.} \\ \;\;\;\;80 \end{array}$$

$$= \frac{\cancel{4}}{\underset{\cancel{4}}{\cancel{12}}} \times \frac{\overset{3}{\cancel{9}}}{\underset{2}{\cancel{14}}} \times \frac{\overset{3}{\cancel{21}}}{\underset{\underset{2}{\cancel{6}}}{\cancel{18}}} \times \frac{7}{2} \text{ lbs. troy.}$$

$$= \frac{7}{8} \text{ lbs. troy.}$$

$$= 10 \text{ oz.} + 10 \text{ dwts.}$$

Question 4.

Reduce each complex fraction to a simple one, then find the value of each in decimals and add or subtract as the case may be.

$$\frac{3\frac{1}{5}}{4\frac{1}{10}} - \frac{5\frac{1}{3}}{10\frac{1}{6}} + \frac{5\frac{1}{7}-3\frac{1}{14}}{7\frac{1}{14}-5\frac{2}{7}} = \frac{\frac{32}{10}}{\frac{41}{10}} - \frac{\frac{32}{6}}{\frac{61}{6}} + \frac{\frac{72}{14}-\frac{43}{14}}{\frac{99}{14}-\frac{74}{14}}$$

$$= \frac{32}{41} - \frac{32}{61} + \frac{29}{25}$$

(By changing each to a decimal fraction.) $= {\cdot}78048 - {\cdot}52459 + 1{\cdot}16$

$= 1{\cdot}41589$ *Ans.*

Question 5.

$$346 \times {\cdot}0035 - \frac{{\cdot}01384}{346} - \frac{{\cdot}2672}{835} = 1{\cdot}211 - {\cdot}00004$$

$$- {\cdot}00032 = 1{\cdot}21064 \quad \textit{Ans.}$$

$$\begin{array}{r} 346 \\ {\cdot}0035 \\ \hline 1730 \\ 1038\; \\ \hline 1{\cdot}2110 \end{array} \qquad \begin{array}{l} 346)\;{\cdot}01384\;({\cdot}00004 \\ \;\;\;\;\;\;\;\;1384 \\ \hline \end{array} \qquad \begin{array}{l} 835)\;{\cdot}2672\;({\cdot}00032 \\ \;\;\;\;\;\;\;\;2505 \\ \hline \;\;\;\;\;\;\;\;1670 \\ \;\;\;\;\;\;\;\;1670 \\ \hline \end{array}$$

Question 6.

$$\left(\frac{1}{\frac{5}{8}} \div \frac{6}{15}\right) \text{of} \cdot 1345 \text{ of lb. troy} = \frac{\cancel{8}}{\cancel{5}} \times \frac{\overset{3}{\cancel{15}}}{\cancel{6}} \times \cdot 1345 \text{ lbs.}$$

$$= \cdot 4035 \text{ lbs.}$$

$$= 4 \text{ oz. } 16 \text{ dwts. } 20\tfrac{4}{25} \text{ gr. } \textit{Ans.}$$

$$\begin{array}{r} .4035 \\ 12 \\ \hline 4\cdot 8420 \\ 20 \\ \hline 16\cdot 840 \\ 24 \\ \hline 336 \\ 168 \\ \hline 20\cdot 16 \end{array}$$

Question 7.

There are two methods of working such questions as this ; the first is to reduce each of the given quantities to its lowest denomination, then divide one by the other, and reduce to its lowest terms, thus:—

$$\begin{array}{rrrrr} \text{m.} & \text{w.} & \text{d.} & \text{h.} & \text{m.} \\ 8 & 3 & 6 & 20 & 59\tfrac{1}{3} \\ 4 & & & & \\ \hline 35 & & & & \\ 7 & & & & \\ \hline 251 & & & & \\ 24 & & & & \\ \hline 1004 & & & & \\ 502 & & & & \\ \hline 6024 & & & & \\ 20 & & & & \\ \hline 6044 & & & & \\ 60 & & & & \\ \hline 362699 & & & & \\ 3 & & & & \\ \hline 1088098 & & & & \end{array}$$

$$\begin{array}{r} 1 \\ 4 \\ \hline 4 \\ 7 \\ \hline 28 \\ 24 \\ \hline 112 \\ 56 \\ \hline 672 \\ 60 \\ \hline 40320 \\ 3 \\ \hline 120960 \end{array}$$

$$\text{Then, } \frac{1088098}{120960} = 8.99551 \text{ Ans.}$$

The second method consists in finding step by step the decimal corresponding to each of the given parts, as follows :—

6,0) 5,9.333333
4) 20.988888
24 = ×
6) 5.247222
7) 6.874537
4) 3.982076
8.995519 *Ans.*

Question 8.

a. r.
133 2
4
534 roods at £. 35 s. 17 d. 9¼ per rood = £. 19,164 s. 9 d. 7½.

s.	d.				
10	0	½	534		
			35		
			2670		
			1602		
			18690		
5	0	½	267		
2	6	½	133	10	
0	3	1/10	66	15	
0	0¼	1/12	6	13	6
				11	1½
			£19,164	9	7½

2) 35 17 9¼
17 18 10½ = the value of 20 perches, or ½ of a rood.
19164 9 7½
£19,182 8 6 *Ans.*

Question 9.

The method of extracting the square and cube roots will be best explained by a friend or teacher.

8·4678 (2·90997 = square root.
4
49)446
441
5809) 57800
52281
58189) 551900
523701
581987) 2819900

Question 9—*(continued)*.

Horner's method of finding the cube root.

0	0	8·4678 (2·0382 = cube root.
2	4	8
2	4	467800
2	8	365427
4	120000	102373000
2	1809	99291872
600	121809	3081128000
3	1818	2492310968
603	12362700	588817032
3	48784	
606	12411484	
3	48848	
6090	1246233200	
8	122284	
6098	1246155484	
8		
6106		
8		
61140		
2		
61142		

By dividing 588 by 124 as follows, the root may be pushed to two more decimal places 2·038247.

124) 588 (47
496
920
868

By dividing 308 by 124 the quotient will be 247.

These hints, of pushing the decimal places in Horner's method of extracting the cube root, are best explained by a teacher.

Question 10.

In proportional questions, always observe *the question* which is *asked*, then find the term similar to the one named in the question asked, and place it on one side of the sign of equality; and write on the other side the explanation of this term as given by the question, thus, "find the rate per cent., or the interest of a 100*l.* for one year," is asked.

(1) $\overset{\pounds}{166}$ = int. produced by a principal of $\overset{\pounds}{1600}$ in 4½ years.

(2) $\overset{\pounds}{\dfrac{166}{1600}}$ = int. produced by a principal of 1*l.* in 4½ years.

(3) $\overset{\pounds}{\dfrac{166 \times 2}{1600 \times 9}}$ = int. produced by a principal of 1*l.* in 1 year.

(4) $\overset{\pounds}{\dfrac{\overset{83}{\cancel{166}} \times \cancel{2} \times \cancel{100}}{\underset{\underset{\underset{4}{\cancel{8}}}{\cancel{16}}}{\cancel{1600}} \times 9}}$ = int. produced by a principal of 100*l.* in 1 year.

$$= \frac{83}{36} = 2\,\frac{11}{36} \text{ rate per cent.}$$

Step 1. 166*l.* is the interest, which is the same element as that which is required. (Find the interest of 100*l.* for 1 yr.)

Step 2. Will a principal of a 1*l.* produce more or less interest, in the same time, than 1600*l.* ? The answer is obviously 1600 times less, then divide by 1600.

Step 3. Will a principal of 1*l.* produce more or less interest in 1 year than 4½ years? The answer is obviously 4½ times less, then divide by 4½ or $\frac{9}{2}$.

Step 4. Will a principal of 1*l.* produce more or less interest, in the same time, than 100*l.* ? The answer is 100 more, then multiply by 100.

Question 11.

384 = days in which 204 men can build ⅖ of a ship working 10¼ hours per day.

384×204 = days in which 1 man can build ⅖ of a ship working 10¼ hours per day.

Question 11—(*continued*).

$\frac{384\times204}{3}$ = days in which 1 man can build $\frac{1}{8}$ of a ship working $10\frac{1}{3}$ hours per day.

$\frac{384\times204\times5}{3}$ = days in which 1 man can build $\frac{5}{8}$ of a ship working $10\frac{1}{3}$ hours per day

$\frac{384\times204\times5}{3\times768}$ = days that 768 men can build $\frac{5}{8}$ of a ship working $10\frac{1}{3}$ hours per day.

$\frac{384\times204\times5\times31}{3\times768\times3}$ = days that 768 men can build $\frac{5}{8}$ of a ship working 1 hour per day.

$\frac{384\times204\times5\times31\times2}{3\times768\times3\times17}$ = days that 768 men can build $\frac{5}{8}$ of a ship working $8\frac{1}{2}$ hours per day.

$$= \frac{620}{3} = 206\tfrac{2}{3} \text{ days.}$$

Step 1. The question asked, how many days? then the element days is placed before the sign of equality, and its explanation after.

Step 2. Will 1 man take more or less days than 204 men to do the same work? The answer is 204 times more, then multiply by 204.

Step 3. Will 1 man take more or less days to build $\frac{1}{8}$ of a ship, than $\frac{3}{8}$ of it? 3 times less, then divide by 3.

Step 4. Will 1 man take more or less days to build $\frac{5}{8}$ of a ship, than $\frac{1}{8}$ of it? 5 times more, then multiply by 5.

Step 5. Will 768 men take more or less days to build $\frac{5}{8}$ of a ship, than 1 man? 768 times less, then divide by 768.

Step 6. Will 768 men take more or less days to build $\frac{5}{8}$ of a ship, when working 1 hour per day, than working $10\frac{1}{3}$ hours? $10\frac{1}{3}$ times more, then multiply by $10\frac{1}{3}$ or $\frac{31}{3}$.

Step 7. Will 768 men take more or less days to build $\frac{5}{8}$ of a ship, when working $8\frac{1}{2}$ hours per day, than working 1 hour? $8\frac{1}{2}$ times less, then divide by $8\frac{1}{2}$ or its equal $\frac{17}{2}$.

The student should be careful to write out the full explanation of each step, until a facility is acquired in working the questions.

Question 12.

$$\begin{array}{rrr} £ & s. & d. \\ 3450 & 4 & 6\frac{1}{2} \\ 20 & & \\ \hline 69004 & & \\ 12 & & \\ \hline 828054 & & \\ 4 & & \\ \hline 3312218 & & \end{array} = \text{farthings} \qquad \begin{array}{rrr} £ & s. & d. \\ 4515 & 9 & 8\frac{1}{4} \\ 3450 & 4 & 6\frac{1}{2} \\ \hline 1065 & 5 & 1\frac{3}{4} \\ 20 & & \\ \hline 21305 & & \\ 12 & & \\ \hline 255661 & & \\ 4 & & \\ \hline 1022647 & & \end{array} = \text{farthings.}$$

$$1065 \quad 5 \quad 1\tfrac{3}{4} = \left\{\begin{array}{l}\text{gain in the}\\ \text{number of}\\ \text{years re-}\\ \text{quired.}\end{array}\right.$$

$1 =$ years that 100*l.* gains $4\frac{3}{4}$*l.*

$100 =$ years that 1*l.* gains $4\frac{3}{4}$*l.*

$\frac{400}{19} =$ years that 1*l.* gains 1*l.*

$\frac{400 \times 1022647}{19 \times 3312218} =$ years that (3450*l.* 4*s.* $6\frac{1}{2}$*d.*) gains (1065*l.* 5*s.* $1\frac{3}{4}$*d.*)

$= \frac{409058800}{62932142} = 6\frac{1}{2}$ years nearly.

Question 13.

$100 =$ principal that will gain $4\frac{3}{4}$*l.* in 1 year.

$\frac{100}{5} =$ principal that will gain $4\frac{3}{4}$*l.* in 5 years.

$\frac{100 \times 4}{5 \times 19} =$ principal that will gain 1*l.* in 5 years.

$\frac{100 \times 4 \times (135l.\ 5s.)}{5 \times 19} =$ principal that will gain 132*l.* 5*s.* in 5 years.

$$= \frac{80 \times 132\frac{1}{4}}{5 \times 19}$$

$= \frac{80 \times 529}{19 \times 4} = \frac{10580}{19} =$ 556*l* 16*s.* $10\frac{2}{19}$*d.* *Ans.*

Question 14.

Men.	App.
84	52
4½	1½
336	52
42	26
378 = shillings.	78 = shillings.

∴ 378 + 78 = 456*s.* being the sum of daily wages of the men and apprentices.

$$\frac{9 \times 4332}{2 \times 456} = 42l.\ 15s. \text{ the man's share.}$$

$$\frac{3 \times 4332}{2 \times 456} = 14l.\ 5s. \text{ the apprentice's share.}$$

Question 15.

£
3540·25
5

177·0125 Divided by 100.
3540·25

3717·2625 = amount at the end ot 1st. year.
5

185·863125
3717·2625

3903·125625 = amount at the end of 2nd. year.
5

195·15628125
3903·125625

4098·28190625 = amount at the end of 3rd. year
5

2)204.9140953125

102·45704765625
4098·28190625

4200·73895390625 = amount at the end of 3½ years.
20 = 4200*l.* 14*s.* 9¼*d.*

14,7790

Question 15—(*continued*).

14, 7790

12

9·348
4

1, 392

Question 16.

$107\frac{3}{4}$ = cost price of 100*l.* by the question.

$\frac{431}{400}$ = cost price of 1*l.*

$\frac{431 \times 14\frac{3}{4}}{400}$ = cost price of 14*l.* 5*s.*

$= \frac{431 \times 59}{400 \times 4}$ = 15*l.* 17*s.* 10¼*d.*

Question 17.

1 shipwright can do $\frac{1}{12}$ part of the work in 46 days.

1 shipwright can do $\frac{1}{12 \times 46}$ part of the work in 1 day.

7 shipwrights can do $\frac{7}{12 \times 46}$ part of the work in 1 day.

1 labourer can do $\frac{1}{16}$ part of the work in 46 days.

1 labourer can do $\frac{1}{16 \times 46}$ part of the work in 1 day.

11 labourers can do $\frac{11}{16 \times 46}$ part of the work in 1 day.

Then, 7 shipwrights and 11 labourers can do $\left(\frac{7}{12 \times 46} + \frac{11}{16 \times 46}\right)$ $= \frac{61}{48 \times 46}$ part of the work in 1 day.

Therefore, $1 \div \frac{61}{48 \times 46} = \frac{48 \times 46}{61} = 36\frac{12}{61}$ days in doing the whole work.

Question 18.

$$\overset{\pounds}{\frac{550}{100}} = \text{the number of 3 per cent. consols.}$$

$$\frac{\overset{\pounds}{550} \times 82\tfrac{3}{8}}{100} = \text{the cost of the 3 per cent. consols.}$$

$$= \overset{\pounds}{453.0625} = \overset{\pounds}{453}\ \overset{s.}{1}\ \overset{d.}{3}.$$

The brokerage on 453·0625 at ⅛ per cent. $= \cdot566328125 = \overset{s.}{11}\ \overset{d.}{3\tfrac{3}{4}}.$

$\therefore\ \overset{\pounds}{453}\ \overset{s.}{1}\ \overset{d.}{3} + \overset{s.}{11}\ \overset{d.}{3\tfrac{3}{4}} = \overset{\pounds}{453}\ \overset{s.}{12}\ \overset{d.}{6\tfrac{3}{4}}$ the cost of the consols.

Question 19.

$$\begin{array}{rrrrr}
\text{Ft.} & \text{in.} & \text{sec.} & & \\
521 & 7 & 11 & & \\
24 & 3 & 7 & & \\
\hline
12519 & 10 & 0 & & \\
130 & 4 & 11 & 9 & \\
25 & 4 & 3 & 7 & 5 \\
\hline
12675 & 7 & 3 & \dot{4} & 5
\end{array}$$

Multiply length by breadth.

$$\text{Then, 12675 ft. at } 9\tfrac{3}{4}d. = \begin{array}{r}
12675 \\
9\tfrac{3}{4} \\
\hline
114075 \\
6337\tfrac{1}{2} \\
3168\tfrac{3}{4} \\
\hline
12)123581\tfrac{1}{4} \\
\hline
2{,}0)1029{,}8\ \ 5d. \\
\hline
514\ \ 18s.\ 5\tfrac{1}{4}d.
\end{array} = 514l.\ 18s.\ 5\tfrac{1}{4}d.$$

$9\tfrac{3}{4}d. = 39$ farthings.

$$\begin{array}{r}
39 \\
7 \\
\hline
12)273 \\
\hline
22\cdot75
\end{array}
\qquad
\begin{array}{r}
12)39 \\
\hline
4)3\cdot25 \\
\hline
\cdot81
\end{array}
\qquad
\begin{array}{r}
12)39 \\
\hline
12)3\cdot25 \\
\hline
3)\cdot27 \\
\hline
\cdot09
\end{array}
\qquad
\begin{array}{r}
22\cdot75 \\
\cdot81 \\
\cdot09 \\
\hline
23\cdot65
\end{array}\ \text{farth.} = 5\tfrac{3}{4}d.$$

Hence $514l.\ 18s.\ 5\tfrac{1}{4}d. + 5\tfrac{3}{4}d. = 514l.\ 18s.\ 11d.$ the cost of planking.

LOGARITHMS.

Logarithms were invented by Lord Napier, a celebrated Scotchman: he is sometimes called Baron Merchiston.

The discovery, which is certainly one of the most important in mathematical science, was made known to the public in a work entitled "Mirifica Logarithmorum Canonis descriptio."

The chief object of logarithms, although used extensively in the higher branches of mathematics, is to facilitate the complex operations of multiplication, division, and extraction of roots in arithmetic. They are indispensible in computing the sides and angles of triangles, as practised in trigonometry, astronomy, and navigation.

The following scheme will convey an idea of the nature of logarithms:

$10^0 = 1$
$10^1 = 10$
$10^2 = 100$
$10^3 = 1000$
$10^4 = 10000$
$10^5 = 100000$
$10^6 = 1000000$
&c. &c.

Thus 10 raised to *nothing* power is 1; 10 raised to the *first* power is 10; 10 raised to the *second* power is 100; 10 raised to the third power is 1000; &c. The numbers 0, 1, 2, 3, 4, &c., are the logarithms to the *natural* numbers 1, 10, 100, 1000, &c., to the *base* 10. In this system of logarithms, the logarithm of each number between 1 and 10 lies between 0 and 1; the logarithm of each number between 10 and 100 lies between 1 and 2; the logarithm of each number between 100 and 1000 lies between 2 and 3; &c.

The late Dr. Hutton published a system of logarithms to the base 10, which is generally used in this country, and contains, besides several useful tables in trigonometry, the logarithms of all *natural* numbers from 1 to 100000.

This book should be obtained, and the method of using it will be best explained orally by a teacher.

Lord Napier's logarithms had the number 2·7182818 for their *base;* it was reserved for Henry Briggs, Savilian Professor of Geometry at Oxford, to point out the advantages of the system of logarithms whose *base* is 10.

Logarithms, whose base is 2·7182818, are called *hyperbolic,* in consequence of a property of the hyperbolic curve connecting its area with these logarithms.

Multiplication and division of numbers are performed by addition and subtraction of logarithms. The squaring of numbers and extraction of roots are performed by multiplication and division of their logarithms.

EXAMPLES.

Section 1.

(1) $53{\cdot}14 \times {\cdot}0047 \times 89$ (2) $36{\cdot}145 \times 1{\cdot}3416 \times {\cdot}5678$

(3) $94{\cdot}575 \times 1{\cdot}0078 \times 3{\cdot}1416$ (4) $1{\cdot}45678 \times 3{\cdot}5678 \times 99$

(5) $32{\cdot}5678 \times {\cdot}004167 \times 583{\cdot}56$ (6) $83{\cdot}456 \times 5{\cdot}6789 \times 1{\cdot}0456$

Section 2.

(7) $456 \times 5{\cdot}367$ (8) $834{\cdot}45 \times 63{\cdot}141$ (9) $586{\cdot}72 \times 58{\cdot}3041$

(10) $831{\cdot}14 \times 1{\cdot}5678$ (11) $3144{\cdot}1 \times {\cdot}16785$ (12) $831{\cdot}146 \times 83{\cdot}1415$

Section 3.

(13) $567{\cdot}14 \div 56{\cdot}384$ (14) $53{\cdot}156 \div 96{\cdot}784$ (15) $8314{\cdot}5 \div 831{\cdot}896$

(16) $3104{\cdot}5 \div 6{\cdot}7859$ (17) $50{\cdot}673 \div 8{\cdot}4678$ (18) $30{\cdot}467 \div 5{\cdot}7312$

Section 4.

(19) $5{\cdot}167 \times 31{\cdot}567 \div 7{\cdot}1416$ (20) $83{\cdot}1417 \times {\cdot}00467 \div {\cdot}0415$

(21) $1{\cdot}04067 \times 5{\cdot}3416 \div {\cdot}00467$ (22) $831{\cdot}837 \times 9{\cdot}1367 \div {\cdot}46783$

(23) $99{\cdot}1416 \times {\cdot}046789 \div 1{\cdot}1416$ (24) $45{\cdot}783 \times 12{\cdot}678 \div 31416$

Section 5.

(25) $\dfrac{34{\cdot}567 \times 34{\cdot}52}{34{\cdot}16 \times 2{\cdot}135}$ (26) $\dfrac{81{\cdot}567 \times 53{\cdot}84}{55 \times 77 \times 3}$ (27) $\dfrac{91{\cdot}56 \times 31456}{56{\cdot}78 \times 32{\cdot}32}$

Section 6.

(28) $\frac{3{\cdot}1416 \times 56{\cdot}314 \times 59}{99{\cdot}998 \times {\cdot}09898}$ (29) $\frac{41{\cdot}567 \times 9{\cdot}8765 \times 3{\cdot}1067}{5{\cdot}9879 \times 9{\cdot}8794 \times 99}$

(30) $\frac{89{\cdot}349 \times 79{\cdot}989 \times 79}{45{\cdot}678 \times 52{\cdot}349 \times 99}$

Section 7.

(31) $31{\cdot}156^2$ (32) $1{\cdot}4167^2$ (33) $81 \times 16 \times 1{\cdot}15^{\frac{1}{5}}$

(34) $81{\cdot}416^{\frac{1}{2}}$ (35) $3{\cdot}1416^3$ (36) $54 \times 1{\cdot}1314 \times \sqrt{5{\cdot}1678}$

Section 8.

(37) $31^2 \times 4^{-3}$ (38) $83^{\frac{1}{5}} \times 31^{-\frac{1}{2}}$

(39) $43{\cdot}167^{\frac{1}{3}} \times 2{\cdot}141^{-3}$ (40) $81{\cdot}1598^{\frac{1}{3}} \times 15{\cdot}178^{-\frac{1}{3}}$

(41) $83{\cdot}76^{\frac{1}{4}} \times 3^{-\frac{1}{3}}$ (42) $85{\cdot}675^{\frac{1}{4}} \times 81{\cdot}375^{-\frac{1}{5}}$

Section 9.

(43) $\frac{31{\cdot}567^{\frac{1}{3}} \times 45{\cdot}67^{\frac{1}{4}}}{83{\cdot}99^{\frac{1}{2}} \times 31{\cdot}98^{\frac{1}{5}}}$ (44) $\sqrt{\frac{84{\cdot}567 \times 99{\cdot}989}{84{\cdot}678 \times 98{\cdot}345}}$

(45) $\sqrt[3]{\frac{3{\cdot}987 \times {\cdot}004999}{{\cdot}0004999 \times 7{\cdot}939}}$

Section 10.

(46) $\frac{\sqrt{5} \times \sqrt{7}}{5^{\frac{1}{3}} \times 19^{\frac{1}{3}}}$ (47) $\frac{\sqrt{3\frac{1}{2}} \times 57^{\frac{1}{3}}}{3{\cdot}1416^{\frac{1}{4}}}$ (48) $\frac{83{\cdot}1516^{\frac{1}{5}} \times 91{\cdot}34^{\frac{1}{6}}}{52{\cdot}1314^{\frac{1}{7}} \times 3{\cdot}14^{\frac{1}{2}}}$

Section 11.

(49) $\left(\frac{56^3 \times 84}{3{\cdot}194 \times 7{\cdot}67^{\frac{1}{3}}}\right)^{\frac{1}{3}}$ (50) $\frac{\sqrt{8{\cdot}987} \times 3{\cdot}989^{\frac{1}{3}}}{5{\cdot}987^{\frac{1}{3}} \times 3{\cdot}46^{\frac{1}{4}}}$

(51) $\sqrt{\frac{3{\cdot}9148^{\frac{1}{5}} \times 984{\cdot}78^{\frac{1}{4}}}{\sqrt{9{\cdot}949} \div 7{\cdot}678}}$

Section 12.

(52) $\dfrac{831^{\frac{1}{4}} \times 5{\cdot}167^{\frac{1}{3}}}{81{\cdot}321^{\frac{1}{5}}}$ (53) $\dfrac{51{\cdot}6783^{2} \times 5378^{\frac{1}{3}}}{\sqrt{91} \times 52^{\frac{1}{3}}}$

(54) $\dfrac{2^{3} \times 5{\cdot}314^{\frac{1}{3}} \times 7{\cdot}345^{\frac{1}{4}}}{9^{\frac{1}{3}} \times 7^{\frac{1}{5}} \times 8{\cdot}534^{\frac{1}{4}}}$

Section 13.

(55) $8{\cdot}946^{-2}$ (56) $5{\cdot}989^{-\frac{1}{3}} \times 68{\cdot}98$

(57) $12{\cdot}845^{-3}$ (58) $9{\cdot}019^{-\frac{1}{5}} \times 10{\cdot}998$

(59) $946{\cdot}57^{-\frac{1}{3}}$ (60) $5{\cdot}897^{-\frac{1}{7}} \times 537{\cdot}89$

Section 14.

(61) $\dfrac{81^{\frac{1}{3}}}{8^{\frac{1}{2}}} \times \dfrac{\sqrt{5}}{\sqrt{15}}$ (62) $\dfrac{51^{\frac{1}{5}}}{86^{\frac{1}{4}}} \times \dfrac{\sqrt{9\frac{1}{2}}}{9\frac{1}{3}}$

(63) $\dfrac{53^{\frac{1}{2}} \times 99^{\frac{1}{3}} \times 100^{\frac{1}{5}}}{5\frac{1}{6} \times \sqrt{33} \times 42^{\frac{1}{4}}}$

Section 15.

(64) $91{\cdot}845^{\frac{2}{3}} \times 7{\cdot}99^{\frac{3}{4}}$ (65) $9^{\frac{2}{5}} \times 7^{\frac{1}{3}} \times 8^{\frac{1}{2}}$

(66) $51{\cdot}789^{\frac{4}{5}} \div 89{\cdot}987^{\frac{3}{5}}$ (67) $505{\cdot}73^{\frac{2}{3}} \times 9{\cdot}847^{-\frac{2}{5}}$

(68) $813{\cdot}146^{\frac{2}{3}} \div 91{\cdot}785^{\frac{3}{4}}$ (69) $85{\cdot}769^{\frac{4}{5}} \div 76{\cdot}789^{-\frac{1}{3}}$

Section 16.

(70) $\dfrac{5\sqrt{24{\cdot}99} \times 7\sqrt[3]{99}}{7\sqrt{54} \times 9\sqrt{32}}$ (71) $\dfrac{7^{-3} \times 9^{-4} \times 11^{-5}}{9^{-5} \times 77^{-2} \times 24^{-6}}$

(72) $\dfrac{99^{\frac{1}{4}} \times 101{\cdot}56^{-\frac{1}{2}} \times 54{\cdot}67^{\frac{1}{3}}}{57^{\frac{1}{2}} \times 83^{-\frac{1}{3}} \times 42{\cdot}893^{-\frac{1}{3}}}$

Section 17.

(73) $(84{\cdot}56 \times 99)^{\frac{1}{5}}$ (74) $(56{\cdot}84 \times 3{\cdot}1416)^{\frac{1}{3}}$

75) $\left(\dfrac{934{\cdot}78 \times 56{\cdot}789}{94{\cdot}32}\right)$

Section 18.

(76) $(73{\cdot}45 \div 567{\cdot}42)^{\frac{1}{2}}$ (77) $\left(\dfrac{83{\cdot}478 \times 56{\cdot}789}{3{\cdot}7854 \times {\cdot}7854}\right)$

(78) $\left(\dfrac{{\cdot}8456 \times {\cdot}004789}{00476 \times 1{\cdot}567}\right)^{\frac{1}{7}}$

Section 19.

(79) $\dfrac{\sqrt[3]{345} \times 432^{\frac{1}{5}}}{987^{\frac{1}{6}} \times 314^{\frac{1}{3}}}$ (80) $\dfrac{83{\cdot}1^{\frac{1}{3}} \times 2{\cdot}1416^{3}}{5{\cdot}178^{3} \times 1{\cdot}432^{4}}$

(81) $\left(\dfrac{8{\cdot}3456^{2} \times 11{\cdot}12^{\frac{1}{5}} \times 78{\cdot}41^{\frac{1}{3}}}{9416^{2} \times {\cdot}0467^{2} \times {\cdot}00056^{3}}\right)$

Section 20.

(82) $\dfrac{43^{2} \times 1{\cdot}467^{3}}{983{\cdot}45^{\frac{1}{3}} \times 17^{\frac{1}{5}}}$ (83) $\left(\dfrac{314^{3} \times 104^{\frac{1}{2}}}{\sqrt{19} \times 3\frac{1}{4} \times 11}\right)$

(84) $\sqrt[3]{\dfrac{3{\cdot}184 \times 67{\cdot}143 \times 1{\cdot}314^{\frac{1}{5}}}{81^{\frac{1}{5}} \times \sqrt{99} \times \sqrt{3^{\frac{1}{3}}}}}$

APPENDIX.

The following Examination Papers, arranged in the order of difficulty, are designed with a view to test the skill and proficiency of the student in the four parts of arithmetic indicated by each section.

EXAMINATION PAPER, No. 1.

SECTION 1.—COMPOUND RULES AND REDUCTION.

1.—Multiply 344*l.* 15*s.* 6½*d.* by 25, and divide the result by 132.

2.—In 134*l.* 5*s.* 6¾*d.* how many farthings are there ?

3.—Find the difference between 20 tons 13 cwt. 17 lbs. 10 ozs. and 11 tons 15 cwt. 2 qrs. 24 lbs. 13 ozs.

4.—Change 24 miles per hour to feet per second.

SECTION 2.—VULGAR AND DECIMAL FRACTIONS.

1.—Find the greatest common measure of 238 and 518.

2.—Find the least common multiple of 12, 18, 26, and 54.

3.—Find the value of $\dfrac{\frac{1}{3} + \frac{1}{4}}{\frac{2}{3} - \frac{3}{4} + 1} \times \dfrac{2}{9} \div \dfrac{14}{22}$.

4.—Change 5*s.* 6½*d.* to the fraction of a guinea.

5.—Find the value of $\dfrac{\cdot010206}{\cdot243} + \dfrac{44\cdot55}{\cdot045}$.

6.—Find the value of $\frac{3}{8}$ of ·4567*l.*

SECTION 3.—PROPORTION, INTEREST, SQUARE AND CUBE ROOTS, AND DUODECIMALS.

1.—If 10 men can do 3 pieces of work in 6½ months, in what time will 52 men do 12 such pieces of work?

2.—Find the interest of 345*l.* 17*s.* 8½*d.* at 4½ per cent. per annum for 3 years.

3.—An article is bought at 3*l.* 10*s.* per unit and sold at 3*l.* 15*s.*; find the gain per cent.

4.—Extract the square root of 74390625, and the cube root of 735580702683.

5.—Find the value of $\overset{\text{ft.}}{34}\ \overset{\text{in.}}{5}\ 7'$ by $\overset{\text{ft.}}{24}\ \overset{\text{in.}}{6}\ 9'$.

SECTION 4.—RATIOS, STOCKS, BROKERAGE, EXCHANGE, ETC.

1.—A and B can do a piece of work in 18 and 24 days respectively, A works 4 days alone; in what time will they finish the remainder together?

2.—Transfer 1500*l.* 3 per cent. stock at 90*l.* to 4 per cents. at 95*l.*, and find the difference in the annual income.

3.—A puts 300*l.* for 4 months and B 400*l.* for 5 months in trade, which realizes a profit of 56*l.*; divide it equitably between them.

4.—Find the amount of a bill which is 40*l.* after the discount at 4 per cent. is deducted.

5.—If the exchange between London and Amsterdam be 36*s.* Flemish per pound sterling, and between Paris and Amsterdam 2 francs per 3*s.* Flemish, how much money sterling must be remitted to Paris, by way of Amsterdam, to discharge a debt of 20,000 francs? And find the *arbitrated* value between London and Paris.

The arbitrated value between Paris and London is the value of a franc in pounds sterling.

EXAMINATION PAPER, No. 2.

SECTION 1.—COMPOUND RULES AND REDUCTION.

1.—Multiply 34 ton. 11 cwt. 15 lbs. 10 ozs. by 37, and divide the result by 563.

2.—Reduce 345679 grains to pounds troy.

3.—Find the value of (346*l.* 15*s.* 9¼*d.* — 198*l.* 19*s.* 11½*d.*) × 49 ÷ 314.

4.—Change 23⅓ feet per second to miles per hour.

SECTION 2.—VULGAR AND DECIMAL FRACTIONS.

1.—Find the greatest common measure of 195, 351, and 423.

2.—Three men start from the same point to travel round an island, whose circumference is 3240 miles, at the rate of 24, 27, and 30 miles per day; where is the second when the first and third are together, and when will they all three be together.

3.—Find the value of $\frac{3\frac{1}{2} - 2\frac{1}{3}}{5\frac{1}{2} - \frac{1}{24}} \div \frac{4\frac{1}{8}}{5\frac{1}{6}} \times \frac{262}{279}$.

4.—Change 18 cwt. 2 qrs. 18 lbs. 10 ozs. 10⅔ drs. to the fraction of 1 ton 4 cwt.

5.—Find the value of $\left(\frac{1\cdot8285}{345} + \frac{80\cdot19}{99} - \frac{\cdot02336}{\cdot73}\right)$ of $\frac{1}{3\frac{1}{2}}$ of ½ a guinea.

SECTION 3.—PROPORTION, INTEREST, SQUARE AND CUBE ROOTS, AND DUODECIMALS.

1.—If 18 men can build a house in 3½ months, working 25 days per month, how many men will build 13 such houses in 6½ months, working 35 days per month?

2.—At what rate per cent. per annum will 350*l.* amount to 399*l.* in 4 years?

3.—An article is bought at 3*l.* 6*s.* 8*d.* per unit; find the selling price so as to gain 8½ per cent.

4.—Extract the square and cube root of $\frac{34}{55}$ to 4 places of decimals.

5.—Find the price of glazing a window 5 ft. 3 in. 9′ by 3 ft. 7 in. 6′, at 2*s.* 6¾*d.* per square foot.

SECTION 4.—RATIOS, STOCKS, BROKERAGE, EXCHANGE, ETC.

1.—3 shipwrights or 7 apprentices can do a piece of work in 14 days; in how many days will 13 shipwrights and 25 apprentices do 3½ times the work?

2.—A merchant buys 3456*l.* of 3½ per cent. stock at 97⅛ and sells out at 93⅝; what does he lose per eent.?

3.—Brass-castings, suitable for the engineer, are composed of 10 parts, by weight, of copper, 1 part of tin, and ⅝ of zinc; find the copper, tin, and zinc in a brass-casting which weighs 1½ cwt.

4.—10 lbs. of beef is worth 8½ lbs. of bacon, and 17 lbs. of bacon is worth 14 lbs. of lamb, and 27 lbs. of lamb is worth 25 lbs. of veal, and 35 lbs. of veal is worth 32 lbs. of mutton, and 56 lbs. of mutton is worth 2*l.* 5*s.*; what quantity of beef can be bought for 15*l.* 15*s.*?

EXAMINATION PAPER, No. 3.

SECTION 1.—COMPOUND RULES AND REDUCTION.

1.—Reduce 84 miles per hour to feet per second.

2.—Find the value of $(\overset{\text{lb.}}{34}\ \overset{\text{oz.}}{8}\ \overset{\text{dwt.}}{13}\ \overset{\text{gr.}}{15} - \overset{\text{lb.}}{19}\ \overset{\text{oz.}}{11}\ \overset{\text{dwt.}}{15}\ \overset{\text{gr.}}{18}) \times 9 \div 37$.

3.—Three men, A, B, and C, walking respectively at the rates of 14, 18, and 22 miles per day, start from the same place to walk in the same direction, round an island 2772 miles in circumference; how many times will each travel round the island before they are together again?

4.—Reduce 18 feet per second to miles per hour.

SECTION 2.—VULGAR AND DECIMAL FRACTIONS.

1.—Find the value of $\frac{\frac{1}{2} + \frac{1}{3}}{\frac{1}{4} - \frac{1}{6}} \times \frac{7}{5} \div \frac{3\frac{1}{4}}{\frac{1}{12}} \div \frac{210}{234}$

2.—Reduce 5*s*. 5⅓*d*. to the fraction of 24*s*. 6*d*.

3.—Find the value of $\left\{\frac{\cdot 00144}{\cdot 32} + \frac{1\cdot 30931}{\cdot 311}\right\}$ of ·125 of a guinea.

4.—Find the value of 9 florins, 5 cents, and 4 milles.

SECTION 3.—PROPORTION, INTEREST, SQUARE AND CUBE ROOTS, DUODECIMALS, ETC.

1.—A piece of work can be done by 22 men in 28 days, working 7 hours per day; in how many days will 77 men do 3½ times the work by working 12 hours per day ?

2.—In what time will 143*l*. 15*s*. 6*d*. amount to 163*l*. 18*s*. $0\frac{3}{4}\frac{2}{25}$*d*. at 4 per cent. per annum simple interest.

3.—Iron is sold at 18*l*. 10*s*. per ton ; what is the prime cost to gain 8½ per cent. ?

4.—Extract the square and cube root of $\frac{3}{17}$ to 4 places of decimals.

5.—Find the expense of glazing 12 windows 4 ft. 5 in. 7′ by 3 ft. 4 in. 9′, at 3*s*. 4½*d*. per foot.

SECTION 4.—RATIOS, STOCKS, BROKERAGE, EXCHANGE, ETC.

1.—A, B, and C can do a piece of work in 8 days, which A and B can do in 14 days, and which B can do in 18 days ; in how many days can A and C do it respectively, and together ?

2.—What is the value of 1344*l*. in the 3 per cent. consols at 84⅛, allowing ⅛ per cent. brokerage on the money paid.

3.—Divide 4400*l*. equitably among 8 officers, at 240*l*. per annum, 2 officers at 400*l*. per annum, and 1 officer at 650*l*. per annum.

4.—How much will a broker, who charges 5½ per cent. per annum discount, give for a bill of 335*l*. due at 3 months ?

EXAMINATION PAPER, No. 4.

SECTION 1.—COMPOUND RULES AND REDUCTION.

1.—The amount of $\frac{2}{5}$ of a ship is 35,478*l.* 17*s.* 8$\frac{1}{2}$*d.*; find the number of farthings the whole ship is worth.

2.—The weekly wages of 48 joiners amount to 73*l.* 13*s.* 9$\frac{1}{4}$*d.*; find the amount which will employ $\frac{1}{8}$ of the number 52 weeks.

3.—A, B, and C start from the same point to travel round an island, 75 miles in circumference; in what time will they be together again, supposing them to be 4, 9, and 24 days in going round? and at what points will they meet together?

4.—Reduce 314157 square yards to acres.

SECTION 2.—VULGAR AND DECIMAL FRACTIONS.

1.—Find the value of $\left\{\frac{3\frac{1}{2} - 1\frac{1}{2}}{5\frac{1}{2} - 3\frac{1}{4}} \times \frac{69}{3\frac{1}{2}} \div \frac{23}{7}\right\}$ of $\frac{1}{8}$ of an acre.

2.—What part of 24*s.* is 7*s.* 4$\frac{1}{2}$*d.*?

3.—Find the value of $\left\{\frac{\cdot001104}{\cdot345} + \frac{\cdot3738}{\cdot0042} - \frac{2\cdot39841}{5\cdot67}\right\}$ of $\frac{1}{88}$ of a guinea.

4.—How many florins, cents, and milles, will pay a bill of 324*l.* 16*s.* 7*d.*?

SECTION 3.—PROPORTION, INTEREST, SQUARE AND CUBE ROOTS, AND DUODECIMALS.

1.—If $\frac{5}{8}$ of $\frac{4}{5}$ of a piece of work can be done by 274 men in 15$\frac{3}{8}$ months, working 35$\frac{3}{4}$ days per month, how many men will do 4$\frac{1}{2}$ such pieces of work in 107$\frac{1}{4}$ months, working 34$\frac{1}{4}$ days per month?

2.—At what rate per cent. per annum will 355*l.* amount to 450*l.* 17*s.* in 6 years?

3.—Find the value of $\sqrt[3]{\frac{1}{4} + \frac{1}{3} + \frac{1}{5} + 1}$ to four places of decimals.

4.—Find the value of paving an area whose length and breadth are 314 ft. 5 in. 7′, and 16 ft. 9 in. 10′, at 6¾*d.* per square yard.

5.—A business man with a fortune of 2340*l.*, buys goods and sells them at a loss of 8½ per cent.; he lives at the rate of 150*l.* per annum, and buys and sells goods to the amount of 2300*l.* per annum. In what time will he contract a debt of 2340*l.*

SECTION 4.—RATIOS, STOCKS, BROKERAGE, EXCHANGE, ETC.

1.—A and B rent a field for 149*l.*; A puts in 20 oxen for 7 weeks, and B 150 sheep for 84 weeks; what should each pay, supposing 3 oxen to eat as much as 28 sheep?

2.—If 94*l.* 12*s.* 6*d.* will buy 100*l.* stock in the 3½ per cents., how much stock can be bought for 665*l.*, allowing for commission ⅜ per cent. upon the stock bought?

It is evident that ⅜*l.* is the amount of commission for each 100*l.* stock.

$$\text{Then } 100l. = \left\{\begin{array}{l}\text{the stock that can be bought for } 94l.\ 12s.\ 6d.\\ +\ 7s.\ 6d. = 95l.\end{array}\right.$$

$$\frac{100 \times 665}{95} = \text{the stock that can be bought for } 665l.$$

$$= 700l. \text{ stock.}$$

3.—100*l.* stock in the 4 per cents. is sold for 98*l.* 17*s.* 6*d.*; how much stock can be bought for 1000*l.*, allowing ⅜ per cent. for commission upon the stock bought?

4.—An express leaves Portsmouth for London at a quarter before 1 o'clock in the morning, and travels at the rate of 35 miles per hour; at what time must the government-train, which travels at the rate of 18 miles in 54 minutes, have left, so that both trains may arrive in London at the same time, the distance being 89 miles?

EXAMINATION PAPER, No. 5.

1.—Find the value of $\dfrac{1}{1+\dfrac{1}{2+\dfrac{1}{7+\frac{1}{2}}}}$, and the converging fractions.

2.—A piece of work can be done by 15 men, or 21 apprentices, in 3½ months. But 33 men and 45 apprentices work at a similar piece of work with the same energy during 2 weeks for the sum of 152*l.*; find the weekly wages of the men and apprentices.

3.—Find the amount of a bill which, when discounted at 3½ per cent., leaves 34*l.* 6*s.* 8*d.*

4.—Transfer 2000*l.* stock from the 3½ per cents. at 85, to 4 per cents. at 92, and find the difference in the annual income.

5.—A, B, and C travel round an island 75 miles in circumference, in 4, 9, and 24 days respectively; they start together; how many days will it be before they are all together again? and at what points round the island will they be together?

6.—Find the value of $\left(\dfrac{1\cdot59137}{\cdot506}+\dfrac{\cdot1739826}{57\cdot42}-\dfrac{\cdot003192}{\cdot007}\right)$ of 5*l.*

EXAMINATION PAPER, No. 6.

1.—Find the value of $1+\dfrac{1}{2+\dfrac{1}{2+\dfrac{1}{1+\frac{1}{2}}}}$, and the converging fractions.

2.—A banker in Paris remits to his factor at Amsterdam 22575 francs, at 3 francs for 51 grotes Flemish, or pence; first to London at 24 francs per £ sterling; thence to Rome at 65*d.* per stamped crown; thence to Venice at 100 stamped crowns for 143 ducats bank; thence to Leghorn at 105 ducats bank for 100 pezze; and from Leghorn to Amsterdam at 87*d.* Flemish per pezza: what does the banker in Paris gain by the circular exchange?

3.—Wheat is composed of carbon, hydrogen, oxygen, and nitrogen in the proportion of 461, 58, 434, and 23 lbs. respectively, for every 976 lbs. of wheat; find the weight of carbon, hydrogen, oxygen, and nitrogen in 1000 tons of wheat.

4.—100*l.* stock in the 3 per cents. is sold for 78⅝*l.*; how much of it can be bought with 500*l.*, allowing ⅛ per cent. for commission on the stock bought?

EXAMINATION PAPER, No 7.

1.—Change $\frac{86400}{20929}$ $\left\{\begin{array}{l}\text{to a continued fraction, and find the}\\ \text{convergents.}\end{array}\right.$

2.—Carbonate of lime contains 1 equi. of calcium, 1 equi. of carbon, and 3 equi. of oxygen; how much calcium, carbon, and oxygen are there in one ton of carbonate of lime, the equi. being 20½, 6, and 8 respectively?

3.—Find the amout of a bill which, when discounted at 4½ per cent., leaves 340*l.* 10*s.* 8*d.*

4.—A youth has just an hour and three-quarters allowed for exercise. He starts off on a coach travelling at the rate of 8¾ miles per hour, and after a time dismounts, and walks home at the rate of 4½ miles per hour; what is the greatest distance he can travel by the coach so as to keep within his time?

5.—Find the value of $\sqrt[3]{\frac{3\frac{1}{2}-1}{7}}$ to four places of decimals.

EXAMINATION PAPER, No. 8.

1.—Find the value of $\frac{\cdot02835}{\cdot07} - \frac{\cdot017984}{\cdot562} - \frac{33\cdot6474}{837}$ of a ton.

2.—If $\frac{5}{8}$ of $\frac{4}{5}$ of a ship can be built by 274 men in $15\frac{3}{8}$ months, working $35\frac{3}{4}$ days per month, how many days per month must 369 men work to build $4\frac{1}{2}$ such ships in $107\frac{1}{4}$ months?

3.—Find the value of

$$\cfrac{1}{20 + \cfrac{1}{2 + \cfrac{1}{7 + \cfrac{1}{5 + \cfrac{1}{2 + \cfrac{1}{1 + \cfrac{1}{3}}}}}}}$$

and also the convergents.

4.—A man being asked what o'clock it was, said that it was between 2 and 3, and that the hour and minute hands were together; find the time of day.

5.—A cistern which holds 960 gallons is filled in 30 minutes by 3 pipes, one of which conveys 15 gallons more, and another 7 gallons less per minute than the third; how much flows through each pipe per minute?

EXAMINATION PAPER, No. 9.

SECTION 1.—THE PROPORTION OF MECHANICS.

When a force acts upon a body, the velocity produced at the end of a unit of time is proportional to the force; and it is proved by experiment that a unit of force will produce in a second a velocity of 32·19 in the same unit of weight.

EXAMPLES.

1.—Find the velocity of a weight of 675·99 lbs. at the end of a second when acted upon by a continued force of 105 lbs.

$$32\cdot19 = \left\{\begin{array}{l}\text{the velocity, produced on a weight of } 675\cdot99\\ \text{lbs. by a force of } 675\cdot99 \text{ lbs., in a second.}\end{array}\right.$$

$$\frac{32\cdot19}{675\cdot99} = \left\{\begin{array}{l}\text{the velocity, produced on a weight of } 675\cdot99\\ \text{lbs. by a force of 1 lb., in a second.}\end{array}\right.$$

$$\frac{32\cdot19 \times 105}{675\cdot99} = \left\{\begin{array}{l}\text{the velocity, produced on a weight of } 675\cdot99\\ \text{lbs. by a force of 105 lbs., in a second.}\end{array}\right.$$

$= 5$ which is usually called the *accelerating force.*

2.—A force of 1372 lbs. acts on a railway-train during 2′ 40″, and produces a velocity of 16·095; find the weight of the train.

$$1 = \left\{\begin{array}{l}\text{the weight on which a force of 1 lb.}\\ \text{will produce a velocity of } 32\cdot19 \text{ in}\\ \text{a second.}\end{array}\right.$$

$$32\cdot19 = \left\{\begin{array}{l}\text{the weight on which a force of}\\ \text{1 lb. will produce a velocity of 1 in}\\ \text{a second.}\end{array}\right.$$

$$\frac{32\cdot19}{16\cdot095} = \left\{\begin{array}{l}\text{the weight on which a force of}\\ \text{1 lb. will produce a velocity of}\\ 16\cdot095 \text{ in a second.}\end{array}\right.$$

$$\frac{32\cdot19 \times 1372}{16\cdot095} = \left\{\begin{array}{l}\text{the weight on which a force of}\\ \text{1372 lbs. will produce a velocity of}\\ 16\cdot095 \text{ in a second.}\end{array}\right.$$

$$\frac{32\cdot19 \times 1372 \times 160}{16\cdot095} \text{ lbs.} = \left\{\begin{array}{l}\text{the weight on which a force of}\\ \text{1372 lbs. will produce a velocity}\\ \text{of } 16\cdot095 \text{ in 160 seconds.}\end{array}\right.$$

$$= \frac{32\cdot19\times1372\times160}{16\cdot095\times2240} \text{ tons, } = 196 \text{ tons.}$$

The mass of a body is equal to its weight divided by 32·19.

3.—A velocity of 8 is produced on a material body at the end of a second by a force of 84 lbs.; required its weight and mass.

4.—A force of 1000 lbs. acting on a material body during a second, produces a velocity of 42; required its weight and mass.

5.—A velocity of 15 is produced at the end of a second, on a material body whose weight is 900 lbs.; required the force acting on it.

6.—A velocity of 30 is produced at the end of a second on a material body whose mass is 6; required the force acting on it.

SECTION 2.

7.—A force of 1400 lbs. acts on a material body whose weight is 1 ton; what is its velocity at the end of a second?

8.—A force of 1555 lbs. acts on a material body whose mass is 12 during a second; required the velocity.

9.—What force, acting a second on a material body whose mass is 32, will produce a velocity of 24.

10.—What force, acting a second on a material body whose weight is 1½ ton, will produce a velocity of 18.

11.—A force of 125 lbs. acts on a body whose weight is 112 lbs. during 8 minutes; find the velocity produced.

12.—What force will produce a velocity of 84 in 3 minutes on a material body whose mass is 5.

SECTION 3.

13.—What is the weight of a body on which a velocity of 39 is produced in 12 seconds by a force of 134 lbs.

14.—A force of 324 lbs. acts on a body whose mass is 3½ during a minute; find the velocity produced.

15.—A force of 2000 lbs. acts on a railway-train during 5 minutes, and produces a velocity of 56; find the weight of the train.

ANSWERS AND EXPLANATIONS

TO

EXERCISES IN ARITHMETIC,

FOR THE USE OF SCHOOLS,

ARTIZANS, AND OTHERS.

BY

ROBERT RAWSON,

Head Master of the Dockyard School, Portsmouth; Honorary Member of the Manchester Literary and Philosophical Society.

SECOND EDITION, REVISED AND CORRECTED,
WITH AN APPENDIX.

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PART THE FIRST.

ANSWERS TO MULTIPLICATION.

Sec.			
1	(1) 713578	(2) 3004068	(3) 27831232
	(4) 45611046	(5) 549311	(6) 2283925
2	(7) 4231467944	(8) 548146848	(9) 62462499
	(10) 31210299	(11) 68094804	(12) 267654280
3	(13) 27839725	(14) 29387032	(15) 19703712
	(16) 10813570	(17) 70707105	(18) 38024679
4	(19) 9625132	(20) 203208956	(21) 875638257
	(22) 485500302	(23) 1930841504	(24) 4524366618
5	(25) 20395002	(26) 19194714	(27) 298586315236
	(28) 2655649230	(29) 56222121296	(30) 272536400
6	(31) 17360367450	(32) 56245335608	(33) 121308396
	(34) 3666306618	(35) 378028308	(36) 545132064
7	(37) 484264116	(38) 642719952	(39) 104882050
	(40) 851839560	(41) 716098695	(42) 2277760253
8	(43) 6927819288	(44) 5270600	(45) 16452705
	(46) 368156334	(47) 1541675234	(48) 14442169196
9	(49) 12344289940	(50) 3219961815	(51) 176577302
	(52) 534020844	(53) 18493934588	(54) 1246636435
10	(55) 2613146256	(56) 3689674256	(57) 56217575700
	(58) 2912956200	(59) 961857359778	

ANSWERS TO DIVISION.

Sec.			
1	(1) 56785	(2) 67854	(3) 78456
	(4) 84380	(5) 345607	(6) 430675
2	(7) 943678	(8) 406735	(9) 304785
	(10) 804678	(11) 304567	(12) 567850
3	(13) 84678904	(14) 3467094	(15) 567095
	(16) 346778	(17) 8909067	(18) 3040678

Sec.			
4	(19) 9046709	(20) 304677	(21) 804678
	(22) 506784	(23) 30467	(24) 80478
5	(25) 40567	(26) 46705	(27) 30467
	(28) 56078	(29) 367804	(30) 56305
6	(31) 367804	(32) 467804	(33) 567804
	(34) 386789	(35) 30467	(36) 804689
7	(37) 38460	(38) 4806	(39) 5678
	(40) 8067	(41) 30467	(42) 5678
8	(43) 30967	(44) $46739\frac{450}{808}$	(45) 36789
	(46) 40678	(47) 56704	(48) 3678
9	(49) 80467	(50) 4767	(51) 5678
	(52) 67809	(53) 567904	(54) 74311
10	(55) 350467	(56) 5798504	(57) 3467856
11	(58) 5060580	(59) 5678045	(60) 9046785
12	(61) 758367	(62) 304678	(63) 830456
13	(64) 567850	(65) 8367804	(66) 3046785
14	(67) 3040674	(68) 830567	(69) 8356780
15	(70) 56784	(71) 853467	(72) 3046704
16	(73) 5067850	(74) $1056822\frac{1721}{13467}$	(75) 3567854
17	(76) 834674	(77) 704356	(78) 904673
18	(79) 45678903	(80) 38567854	(81) 567894354
19	(82) 83675069	(83) 560785430	
20	(84) 306078004	(85) 799547 Rem. 95414	

ANSWERS TO REDUCTION.

Sec.		
1	(1) 606720 ft.	(2) 358848 ft.
	(3) 438240 ft.	(4) 59*l.* 3*s.* 1¼*d.*
	(5) 787*gs.* 5*s.* 10½*d.*	(6) 18248*l.* 3*s.* 11*d.*
2	(7) 53128 ft.	(8) 1003999
	(9) 418549 ft.	(10) 7 crowns and 3*d.*
	(11) 1376 *gs.* 2*s.* 9*d.*	(12) 45*l.* 11*s.* 9¼*d.*
3	(13) 332906 ft.	(14) 8128834
	(15) 8296122	(16) 83040
	(17) 56040	(18) 56*gs.* 7*s.* 0¼*d.*

Sec.				
4	(19)	70 pieces, 7*s.* 10*d.*	(20)	3*l.* 12*s.* 2¾*d.*
	(21)	15*gs.* 7*s.* 3*d.*	(22)	5451630
	(23)	333111	(24)	5451775
5	(25)	71680	(26)	107520
	(27)	2007040	(28)	15 t. 18 cwt. 2 qr. 6 lb.
	(29)	261 t. 19 cwt. 0 qr. 16 lb.	(30)	164064 t. 9 cwt. 0 qr. 8 lb.
6	(31)	126560	(32)	76160
	(33)	1942496	(34)	16343040
	(35)	20 t. 17 cwt. 2 qr. 25 lb.	(36)	253 t. 10 cwt. 0 qr. 10 lb.
7	(37)	253440	(38)	124428
	(39)	10m. 6f. 1p. 2y. 2ft. 6in.	(40)	4 m. 7 f. 26 p. 1 yd. 0 ft. 3 in.
	(41)	32 m. 5 f. 34 p.	(42)	39739
8	(43)	74880	(44)	86808
	(45)	272 lb. 2 oz. 7 ds. 6 gr.	(46)	124 lb. 9 oz.
	(47)	662645	(48)	141 lb. 2 oz. 18 dwt. 15 gr.
9	(49)	54432	(50)	67392
	(51)	4 sq. yd. 3 sq. ft. 62 sq. in.	(52)	26 sq. yd. 6 sq. ft. 118 sq. in.
	(53)	103806	(54)	275 sq. yd. 2 sq. ft. 92 sq. in.
10	(55)	336	(56)	224
	(57)	196 a. 2 r. 27 p.	(58)	18817920
	(59)	9640678	(60)	11 a. 2 r. 37 p. 5¾ yds.
11	(61)	2560	(62)	30720
	(63)	98 l. 1 q. 5 b. 1 p. 1 g.	(64)	221 l. 4 qr. 0 b. 2 p. 1 g. 3 q.
	(65)	4476	(66)	2218 l. 2 q. 5 b. 0 p. 0 g. 3 q.
12	(67)	432000	(68)	1050030
	(69)	4 d. 0 h. 19 m. 49 s.	(70)	62 y. 7 m. 2 w. 4 d. 17 h.
	(71)	1 f. 156 yd. 2 ft. 7 in.	(72)	38640
13	(73)	5 lb. 5 oz. 11 dwt. 3 gr.	(74)	1 m. 1 w. 5 d. 3 h. 17 m. 36 s.
	(75)	13 cwt. 0 q. 10 lb. 11 oz.	(76)	17 a. 0 r. 39 p. 7¼ yds.
	(77)	2448	(78)	6 d. 13 h. 43 m. 25 s.
14	(79)	8334*d.*	(80)	829440
	(81)	79902	(82)	5517795
	(83)	3612*l.* 6*s.* 11¼*d.*	(84)	96*l.* 5*s.*
	(85)	112787	(86)	9 t. 12 cwt. 3 qr. 16 lb. 14 oz.
	(87)	253 t. 10 cwt. 0 qr. 14 lb.	(88)	4872
	(89)	17616	(90)	54 lb. 9 oz. 13 dwt. 6 gr.

Sec.

16 (91) 221 l. 4q. 0b. 2p. 1g. 3q. (92) 174qr. 1b. 2p. 1g. 2qu. 0p. 1g.
(93) 9070 (94) 13504
(95) 65 y. 10 h. (96) 29016

17 (97) 4872 (98) 17616
(99) 342 *gs.* 19*s.* $7\frac{1}{2}$*d.*
(100) 54 lb. 9 oz. 13 dwt. 6 g. ; 45 lb. 1 oz. 8 dr.
(101) 11860

18 (102) 105600 (103) 5950m. 1f. 7p. 3y. 0f. 6in.
(104) 2135 a. 1 r. 38 p. (105) $10587\frac{1}{2}$
(106) 1372140 (107) 1 yd. 5 ft. 1489 in.

19 (108) 1617540 (109) 44940
(110) 62 w. 6 d. 16 h. 7 m. (111) 7380
(112) 14239 (113) 157339

20 (114) 185696 (115) 17 cwt. 2 qr. 6 lbs. 11 oz.
(116) 1809601920 (117) 29174
(118) 3456 (119) 81180

21 (120) 196 a. 1 r. 16 p. (121) 1 m. 1 w. 4 d. 10 h. 24 m.
(122) $19329\frac{3}{4}$ (123) 1652
(124) 186 t. 19 cwt. 1 q. 15 lb. 10 oz.
(125) 247 oz. 18 dwts. 8 gr.

22 (126) 20777 (127) 4495 (128) 229536
(129) 2766 (130) 388 — 1*d.* (131) 3 d. 11 h. 20 m.

23 (132) 44 (133) 66 (134) $70\frac{7}{8}$
(135) $37\frac{2}{5}$ (136) $52\frac{1}{15}$ (137) $68\frac{1}{3}$

24 (138) $10\frac{10}{11}$ (139) $16\frac{4}{11}$ (140) $17\frac{8}{11}$
(141) $13\frac{71}{88}$ (142) $23\frac{23}{44}$ (143) $21\frac{2}{11}$

25 (144) $36\frac{3}{10}$ (145) 88 (146) $95\frac{7}{10}$
(147) $54\frac{19}{80}$ (148) $68\frac{1}{3}$ (149) 77

26 (150) $37\frac{1}{3}$ (151) $23\frac{23}{44}$ (152) $30\frac{15}{88}$
(153) $36\frac{1}{44}$ (154) $21\frac{41}{44}$ (155) $17\frac{79}{88}$

27 (156) $33\frac{11}{15}$ (157) $26\frac{2}{3}$ (158) $23\frac{7}{15}$
(159) $50\frac{2}{3}$ (160) $76\frac{23}{45}$ (161) $48\frac{1}{80}$
(162) $81\frac{1}{80}$ (163) 88 (164) $14\frac{3}{10}$
(165) $12\frac{5}{8}$

ANSWERS TO ADDITION.

Sec.				
1	(1)	356*l.* 17*s.* 0*d.*	(2)	1177*l.* 13*s.* 11*d.*
	(3)	587*l.* 13*s.* 0¾*d.*	(4)	3092*l.* 8*s.* 10¾*d.*
2	(5)	2088*l.* 17*s.* 4½*d.*	(6)	23802*l.* 10*s.* 4½*d.*
	(7)	17123*l.* 1*s.* 1¼*d.*	(8)	4025*l.* 15*s.* 7½*d.*
3	(9)	3458*l.* 7*s.* 11½*d.*	(10)	14963*l.* 5*s.* 5½*d.*
	(11)	15237*l.* 18*s.* 10*d.*	(12)	8715*l.* 2*s.* 4¾*d.*
4	(13)	9271*l.* 0*s.* 6*d.*	(14)	3661*l.* 10*s.* 0¾*d.*
	(15)	4537*l.* 8*s.* 4½*d.*	(16)	7344*l.* 17*s.* 11*d.*
5	(17)	260 t. 1 cwt. 3 qr. 16 lb.	(18)	1871 t. 17 cwt. 2 qr. 15 lb.
	(19)	372 qr. 22 lb. 15 oz. 10 dr.	(20)	949 qr. 1 lb. 15 oz.
6	(21)	563t. 15cwt. 0qr. 12lb.	(22)	1031 t. 19 cwt. 2 qr. 20 lb.
	(23)	512qr. 25lb. 6oz. 2 dr.	(24)	6214qr. 24lb. 14oz. 0dr.
7	(25)	582lb. 3oz. 15dwt. 21gr.	(26)	1311 lb. 6 oz. 9 dwt. 18 gr.
	(27)	434 oz. 7 dr. 0 sc. 9 gr.	(28)	567 lb. 5 oz. 4 dr. 1 sc.
8	(29)	567 p. 1 yd. 0 ft. 7 in.	(30)	1310 p. 2 yds. 0 ft. 11 in.
	(31)	859 a. 3 r. 1 p. 1¾ s. y.	(32)	487 a. 1 r. 35 p. 10½ yd.
9	(33)	611 ld. 3 q. 7 b. 1 p.	(34)	926 ld. 4 qr.
	(35)	547 bush.	(36)	533 b. 3 p. 1 g. 3 qu.
10	(37)	407 d. 22 h. 7 m. 53 sec.	(38)	401 d. 5 h. 18 m. 7 sec.
	(39)	591 m. 0 w. 2 d. 5 h.	(40)	913 m. 3 w. 0 d. 9 h.
11	(41)	464 qr. 13 lb. 4 oz. 15 dr.	(42)	2643 qr. 4 lb. 10 oz. 12 dr.
	(43)	4224t. 15cwt. 0qr. 12lb.	(44)	589 t. 11 cwt. 2 qr. 5 lb.
12	(45)	4759 lb. 7 oz. 5 dwt. 5 gr.	(46)	5899lb. 7oz. 10 dwt. 15gr.
	(47)	5472 lb. 1 oz. 3 dr. 1 sc.	(48)	4966 oz. 0 dr. 0 sc. 11 gr.
13	(49)	570 p. 4 yds. 1 ft. 8 in.	(50)	417 p. 3 yd. 0 ft. 2 in.
	(51)	488 m. 7 f. 198 yd. 1 ft.	(52)	3684 m. 7 f. 151 yd. 1 ft.
14	(53)	1898 a. 2 r. 30 p. 12¼ yd.	(54)	2900 a. 2 r. 21 p. 26¼ yd.
	(55)	2108 p. 11 yd. 2 ft. 104 in.	(56)	4072 p. 18½ yd. 8 ft. 48 in.
15	(57)	4026 yd. 21 ft. 1251 in.	(58)	3513 yd. 25 ft. 233 in.
	(59)	3188 ld. 3 qr. 1 b. 0 p.	(60)	3697 l. 1 q. 0 b. 3 p.
16	(61)	5731 d. 19 h. 26 m. 32 s.	(62)	6454 m. 2 w. 3 d.
	(63)	21923*l.* 2*s.* 1¼*d.*	(64)	50404*l.* 10*s.* 9¼*d.*
17	(65)	4972 t. 10 cwt.	(66)	4434 qr. 26 lb.
	(67)	5207lb. 10oz. 18dwt. 17g.	(68)	4832lb. 8oz. 3dr. 2sc.
18	(69)	5924 p. 2 yd. 1 ft. 4 in.	(70)	6541 a. 2 r. 31 p. 10 yd.
	(71)	7392 ld. 0 q. 5 b. 1 p.	(72)	6938 m. 0 w. 4 d. 18 h.
19	(73)	57680*l.* 16*s.* 0½*d.*	(74)	7005 cwt. 8lb. 15 oz. 1 dr.
	(75)	7257 lb. 1 oz. 8 dwt. 1 gr.	(76)	6643 a. 0 r. 37 p. 11½ yd.

ANSWERS TO SUBTRACTION.

Sec.		
1	(1) 213*l.* 1*s.* 4½*d.*	(2) 235*l.* 18*s.* 11½*d.*
	(3) 342*l.* 15*s.* 5½*d.*	(4) 377*l.* 17*s.* 6½*d.*
2	(5) 138*l.* 12*s.* 6½*d.*	(6) 83*l.* 18*s.* 1½*d.*
	(7) 13*l.* 12*s.* 9½*d.*	(8) 1080*l.* 17*s.* 7¾*d.*
3	(9) 368*l.* 1*s.* 5¾*d.*	(10) 57*l.* 16*s.* 9¾*d.*
	(11) 81*l.* 17*s.* 9¼*d.*	(12) 251*l.* 6*s.* 6¾*d.*
4	(13) 135*l.* 15*s.* 9¾*d.*	(14) 157*l.* 17*s.* 6¼*d.*
	(15) 337*l.* 15*s.* 7¾*d.*	(16) 88*l.* 16*s.* 10¾*d.*
5	(17) 156t. 16cwt. 2qr. 24lb.	(18) 81t. 3cwt. 2qr. 17lb.
	(19) 247qr. 18lb. 13oz. 13dr.	(20) 227qr. 15lb. 13oz. 11dr.
6	(21) 187lb. 8oz. 14dwt. 15gr.	(22) 206lb. 5oz. 17dwt. 22gr.
	(23) 272lb. 4oz. 16dwt. 16gr.	(24) 77lb. 10oz. 15dwt. 18gr.
7	(25) 188lb. 9oz. 1dr. 2sc.	(26) 88lb. 6oz. 2dr. 1sc.
	(27) 188oz. 5dr. 1sc. 16gr.	(28) 388oz. 2dr. 0sc. 15gr.
8	(29) 67p. 1yd. 1ft. 10in.	(30) 175p. 3yd. 1ft. 8in.
	(31) 52m. 4f. 134yd. 1ft.	(32) 75m. 5f. 206yd. 2ft.
9	(33) 282a. 1r. 21p. 23¼yd.	(34) 86a. 1r. 34p. 23¼yd.
	(35) 157p. 24yd. 1ft. 7in.	(36) 273p. 23yd. 8ft. 73in.
10	(37) 188l. 2q. 4b. 3p.	(38) 383l. 2q. 3b. 2p.
	(39) 177b. 2p. 0gal. 3qt.	(40) 188b. 3p. 0gal. 3qt.
11	(41) 278m. 7d. 19h. 40m.	(42) 176w. 4d. 15h. 39m.
	(43) 86d. 17h. 40m. 30sec.	(44) 78d. 4h. 46m. 50sec.
12	(45) 887*l.* 15*s.* 9¾*d.*	(46) 1886*l.* 15*s.* 10¾*d.*
	(47) 3888*l.* 16*s.* 10¼*d.*	(48) 1887*l.* 16*s.* 10½*d.*
13	(49) 388t. 15cwt. 1qr. 25lb.	(50) 188t. 15cwt. 1qr. 4lb.
	(51) 388qr. 17lb. 13oz. 4dr.	(52) 388qr. 14lb. 2oz. 9dr.
14	(53) 188lb. 9oz. 17dwt. 22gr.	(54) 588lb. 9oz. 18dwt. 13gr.
	(55) 767lb. 7oz. 14dwt. 21gr.	(56) 1885lb. 6oz. 11dwt. 16gr.
15	(57) 186lb. 7oz. 4dr. 2sc.	(58) 86lb. 7oz. 5dr. 2sc.
	(59) 188oz. 3dr. 1sc. 17gr.	(60) 388oz. 2dr. 1sc. 6gr.
16	(61) 178m. 3f. 31p. 4½yd.	(62) 287m. 2f. 29p. 1½yd.
	(63) 186p. 3½yd. 1ft. 11in.	(64) 88p. 3½yd. 0ft. 8in.

Sec.				
17	(65)	54a. 1r. 25p. 19¼yd.	(66)	178a. 2r. 19p. 23¼yd.
	(67)	377p. 18¼yd. 5ft. 137in.	(68)	388p. 3¼yd. 3ft. 124in.
18	(69)	187l. 1qr. 4b. 2p.	(70)	586l. 1qr. 5b. 3p.
	(71)	186b. 2p. 0g. 2q.	(72)	388b. 1p. 0g. 2q.
19	(73)	284m. 1w. 4d. 13h.	(74)	188m. 2w. 4d. 19h.
	(75)	342d. 15h. 47m. 50sec.	(76)	188d. 9h. 51m. 51sec.
20	(77)	241cwt. 93lb. 12oz. 10dr.	(78)	155lb. 5oz. 17dwt. 22gr.
	(79)	388oz. 4dr. 1sc. 16gr.	(80)	188p. 2½yd. 1ft. 10in.
21	(81)	68a. 1r. 25p. 28¼yd.	(82)	188l. 1q. 5b. 3p.
	(83)	233m. 2w. 4d. 18h.	(84)	77d. 19h. 36m. 47sec.

ANSWERS TO COMPOUND MULTIPLICATION AND DIVISION.

Sec.				
1	(1)	137*l.* 9*s.* 6*d.*	(2)	3383*l.* 10*s.* 6*d.*
	(3)	3407*l.* 9*s.* 10½*d.*		
2	(4)	2515*l.* 1*s.* 10*d.*	(5)	5107*l.* 13*s.* 6¾*d.*
	(6)	108*l.* 12*s.* 10½*d.*	(7)	6617*l.* 6*s.* 4½*d.*
3	(8)	56*l.* 17*s.* 8¾*d.*	(9)	83*l.* 19*s.* 9½*d.*
	(10)	56*l.* 7*s.* 1¾*d.*	(11)	83*l.* 9*s.* 10½*d.*
	(12)	14*l.* 15*s.* 5¼*d.*		
4	(13)	2242*l.* 11*s.* 6*d.*	(14)	4265*l.* 7*s.* 3*d.*
	(15)	7595*l.* 15*s.* 7½*d.*	(16)	5183*l.* 1*s.* 4¾*d.*
	(17)	8110*l.* 3*s.* 8*d.*	(18)	144540*l.* 7*s.* 10½*d.*
5	(19)	143*l.* 0*s.* 7¾*d.*	(20)	186*l.* 17*s.* 7½*d.*
	(21)	5607*l.* 4*s.* 3½*d.*		
6	(22)	88339*l.* 7*s.* 5½*d.*	(23)	65880*l.* 11*s.* 2½*d.*
	(24)	111480*l.* 5*s.* 7*d.*	(25)	10366*l.* 2*s.* 1*d.*
	(26)	36966*l.* 2*s.* 8½*d.*	(27)	33648*l.* 5*s.* 9½*d.*
7	(28)	3560*l.* 5*s.* 5½*d.*	(29)	867*l.* 2*s.* 2½*d.*
	(30)	567*l.* 15*s.* 1½*d.*		
8	(31)	946*l.* 18*s.* 8¼*d.*	(32)	506*l.* 8*s.* 4½*d.*
	(33)	946*l.* 15*s.* 5¾*d.*		

Sec.

9 (34) 160125*l.* 18*s.* 3¾*d.* (35) 63805*l.* 6*s.* 6*d.*
(36) 24414*l.* 11*s.* 10½*d.* (37) 33172*l.* 2*s.* 1½*d.*
(38) 16983*l.* 10*s.* 6¾*d.* (39) 4164*l.* 6*s.* 8*d.*

10 (40) 12*s.* 0¾*d.* (41) 8*l.* 16*s.* 3¾*d.*
(42) 24*l.* 9*s.* 9¾*d.*

11 (43) 3059 a. 0 r. 22 p. (44) 912 a. 1 r. 12 p. 15 yd.
(45) 505 yd. 8 ft. 32 in.

12 (46) 10*l.* 0*s.* 5*d.* (47) 19*l.* 2*s.* 11½*d.*
(48) 1*l.* 3*s.* 8½*d.*

13 (49) 221 m. 7 f. 5 p. 5 y. (50) 19164 m. 0 f. 31 p. 2 y.
(51) 13164 yd. 0 ft. 9 in.

14 (52) 2*l.* 8*s.* 11½*d.* (53) 17*s.* 10½*d.*
(54) 2*l.* 1*s.* 9¼*d.*

15 (55) 14*l.* 13*s.* 9½*d.* (56) 10*l.* 9*s.* 9*d.*
(57) 1 cwt. 2 qr. 0 lb. 10 oz. $6\frac{2}{37}$ dr.

16 (58) 264 t. 16 cwt. 2 qr. (59) 50298*l.* 7*s.* 8½*d.*
(60) 24 t. 3 cwt. 1 qr. 20 lb. 2 oz. (61) 723 lb. 10 oz. 7 dwt. 6 gr.
(62) 4262 lb. 3 oz. 2 dr. 2 s. 14 gr.

17 (63) 327 yd. 2 ft. 7 in. (64) 363 a. 3 r. 39 p. 6¼ yd.
(65) 688 l. 3 q. 7 b. 1 p. (66) 1237 m. 3 w. 4 d. 19 h.

18 (67) 25584 t. 0 cwt. 1 qr. 2 lb. (68) 50523 t. 0 cwt. 2 qr. 23 lb.
(69) 19361 a. 2 r. 24 p.

19 (70) 10281 a. 2 r. 16 p. (71) 12834 c. yd. 26 c. ft. 1428 c. in.
(72) 4102 c. yd. 16 c. ft. 632 c. in.

20 (73) 7268 w. 5 d. 11 h. 38 m. (74) 12857 w. 4 d. 11 h. 18 m.
(75) 4336 lb. 4 oz. 11 dwt. 6 gr.

21 (76) 8012 lb. 1 oz. 14 dwt. 23½ gr. (77) 5048 l. 1 q. 4 b. 1 p. 0 g.
(78) 2117 l. 0 q. 5 b. 2 p. 0 g.

22 (79) 4438 lb. 8 oz. 6 dr. 2 sc. 13 gr.
(80) 587 lb. 0 oz. 6 dr. 2 sc. 12½ gr.
(81) 23607 t. 10 cwt. 3 qr. 12 lb.

23 (82) 6754 a. 2 r. 24 p. (83) 6240 c. yd. 24 c. ft. 720 c. in.
(84) 16647 w. 0 d. 17 h. 24 m.

Sec.
24 (85) 9076 lbs. 5 oz. 8 dwt. $3\frac{2}{5}$ gr.
(86) 6823 l. 4 q. 7 b. 1 p. 1 g.
(87) 1245 lb. 4 oz. 4 dr. 0 sc. 15 gr.

25 (88) 1230 t. 11 cwt. 1 qr. $10\frac{1}{2}$ lb. (89) 952 t. 5 cwt. 2 qr. $4\frac{4}{5}$ lb.
(90) 3228 t. 3 cwt. 2 qr. $9\frac{1}{3}$ lb.

26 (91) 1111*l.* 10*s.* 6*d.* (92) 5021*l.* 14*s.* $1\frac{3}{4}$*d.*
(93) 12077*l.* 10*s.* $7\frac{1}{2}$*d.*

27 (94) 4066 lb. 3 oz. 5 dwt. $0\frac{1}{3}$ gr. (95) 6795 lb. 0 oz. 7 dwt. $15\frac{6}{7}$ gr.
(96) 5277 lb. 10 oz. 13 dwt. $11\frac{1}{3}$ gr.

28 (97) 8761 lb. 0 oz. 7 dr. 0 sc. $3\frac{4}{7}$ gr.
(98) 4778 lb. 5 oz. 4 dr. 0 sc. $14\frac{3}{5}$ gr.
(99) 2339 lb. 7 oz. 4 dr. 2 sc. $3\frac{5}{8}$ gr.

29 (100) 81*l.* 5*s.* $9\frac{3}{4}$*d.* (101) 1039*l.* 12*s.* $8\frac{3}{4}\frac{10}{13}$*d.*
(102) 8*l.* 1*s.* $1\frac{1}{2}$*d.*

30 (103) 2673*l.* 18*s.* (104) 190*l.* 5*s.* $8\frac{1}{2}$*d.*
(105) 2835*l.*

31 (106) 33*l.* 6*s.* $10\frac{1}{2}$*d.* (107) 18*l.* 1*s.* $8\frac{1}{4}$*d.*
(108) 667*l.* 16*s.* $6\frac{1}{4}$*d.*

32 (109) 467*l.* 13*s.* $7\frac{1}{2}$*d.* (110) 346*l.* 17*s.* $9\frac{3}{4}$*d.*
(111) 834*l.* 13*s.* $4\frac{3}{4}$*d.*

33 (112) 567*l.* 15*s.* $7\frac{3}{4}$*d.* (113) 137*l.* 16*s.* $7\frac{1}{4}$*d.*
(114) 147*l.* 0*s.* $3\frac{3}{4}$*d.*

34 (115) 56 t. 15 cwt. 2 qr. 17 lb. (116) 156 t. 13 cwt. 3 qr. 27 lb.
(117) 87 t. 12 cwt. 1 qr. 24 lb.

35 (118) 1 lb. 1 oz. 4 dwt. $5\frac{81}{187}$ gr. (119) 10 lb. 0 oz. 3 dwt. $12\frac{170}{387}$ gr.
(120) 8 oz. 17 dwt. $14\frac{407}{487}$ gr.

36 (121) 346 lb. 10 oz. 5 dr. 2 sc. 14 gr.
(122) 34 lb. 5 oz. 6 dr. 1 sc. 13 gr.
(123) 342 lb. 1 oz. 7 dr. 0 sc. 19 gr.

37 (124) 45 m. 7 f. 25 p. 2 yd. (125) 56 m. 3 f. 23 p. 3 yd.
(126) 34 m. 0 f. 27 p. 2 yd.

38 (127) 35 a. 2 r. 37 p. 30 yd. (128) 513 a. 3 r. 34 p. $25\frac{35}{78}$ yd.
(129) 314 a. 2 r. 5 p. 23 yd.

39 (130) 34 c. y. 24 c. ft. 136 c. in. (131) 56 c. y. 26 c. ft. 1367 c. in.
(132) 132 c. y. 13 c. ft. 516 c. in.

Sec.
40 (133) 517 s.y. 8 s.ft. 132 s.in. (134) 314 s.y. 3 s.ft. 112 s.in.
(135) 516 s.y. 2 s.ft. 115 s.in.
41 (136) 67 d. 21 h. 34 m. 15 s. (137) 57 d. 13 h. 5 m. 17 s.
(138) 314 d. 17 h. 34 m. 46 s.
42 (139) 132 l. 3 qr. 7 b. 3 p. (140) 145 l. 2 qr. 3 b. 2 p.
(141) 172 l. 3 qr. 7 b. 3 p.
43 (142) 467*l.* 13*s.* 7½*d.* (143) 346*l.* 17*s.* 9¾*d.*
(144) 834*l.* 13*s.* 4¾*d.*
44 (145) 137*l.* 16*s.* 7¼*d.* (146) 567*l.* 15*s.* 7¾*d.*
(147) 45*l.* 1*s.* 3⅓*d.*
45 (148) 2*l.* 11*s.* 8*d.* (149) 3*l.* 4*s.* 9⅐*d.*
(150) 10*l.* 8*s.* 4¾*d.* (151) 14*l.* 8*s.* 4¾*d.*
46 (152) 185*l.* 14*s.* 8¾*d.* (153) 42*l.* 11*s.* 0½*d.*
(154) 69*l.* 14*s.* 9½*d.* (155) 115*l.* 6*s.* 5⅓*d.*
47 (156) 134*l.* 0*s.* 4¼*d.* (157) 282*l.* 10*s.* 11¼*d.*
(158) 571*l.* 2*s.* 3*d.* (159) 415*l.* 13*s.* 1¾*d.*
48 (160) 39 t. 17 cwt. 0 qr. 21 lb. (161) 124 lb. 3 oz. 2 dwt. 6 gr.
(162) 75 t. 4 cwt. 2 qr.
49 (163) 7 (164) 17 (165) 37 (166) 132
(167) 9 (168) 157
50 (169) 18 (170) 143 (171) 31 (172) 122
51 (173) 156 (174) 87 (175) 104 (176) 236
52 (177) 56 (178) 133 (179) 167 (180) 56

ANSWERS TO THE GREATEST COMMON MEASURE.

Sec.
1 (1) 8 (2) 11 (3) 85 (4) 13 (5) 17 (6) 26
2 (7) 1 (8) 34 (9) 39 (10) 56 (11) 87 (12) 98
3 (13) 13 (14) 15 (15) 1 (16) 27 (17) 54 (18) 6
4 (19) 4 (20) 7 (21) 11 (22) 9 (23) 15 (24) 2
5 (25) 55 (26) 46 (27) 9 (28) 19 (29) 8

Find the greatest common measure of 1026, 1938, and 2109.

First find the greatest common measure of 1026, 1938; which is 114.

Then, find the greatest common measure of 114 and 2109; which is 57.

Therefore, 57 is the greatest common measure required.

6 (30) 4 (31) 9 (32) 7 (33) 6
7 (34) 1 (35) 18 (36) 5 (37) 1
8 (38) 5 (39) 8 (40) 88 (41) 16

ANSWERS TO THE LEAST COMMON MULTIPLE.

Sec.					
1	(1) 63	(2) 200	(3) 234	(4) 150	(5) 216
2	(6) 120	(7) 624	(8) 189	(9) 312	(10) 396
3	(11) 48	(12) 1232	(13) 360	(14) 546	
4	(15) 13860	(16) 125970		(17) 3527160	
5	(18) 720	(19) 17635800		(20) 30240	
6	(21) 9360	(22) 1836		(23) 1348848	

(24) 144 days, A in 12 times, B 9 times, and C 8 times.

Four bells commence tolling together, and toll at intervals of 18, 45, 81, and 105 seconds respectively; what time will elapse before they again toll simultaneously? *(Cambridge Examination Papers.)*

Find the least common multiple of 18, 45, 81, and 105, which will be the time in seconds = 1½ hour 4½ minutes.

ANSWERS TO MISCELLANEOUS EXAMPLES.

Sec.

1 (1) 146725569144 (2) 56790405
(3) 208 t. 17 cwt. 1 qr. 4 lb. (4) 2031744
(5) 56 lb. 9 oz. 15 dwt. 22 g. (6) 1001 lb. 7 oz. 8¼ drs.
(7) 1078lb. 4oz. 14dwt. $14\frac{1}{17}$g. (8) 64
(9) $28\frac{3}{5}$ (10) $21\frac{21}{44}$ (11) $49\frac{13}{15}$

2 (1) 27885876528 (2) 4067845
(3) 361*l.* 4*s.* 8¼*d.* (4) 555522
(5) 57 (6) 4618*l.* 13*s.* 8¾*d.*
(7) 45554*l.* 7*s.* 6¾*d.* (8) 1416*l.* 13*s.* 8½*d.*
(9) $47\frac{3}{10}$ (10) $3\frac{81}{88}$ (11) $76\frac{4}{15}$

3 (1) Eight hundred and four million, fifty-six thousand and seventy. (2) 567843
(3) 2 t. 14 cwt. 2 qr. 15 lb. 12 oz. 13 drs.
(4) 103199 (5) 1t. 4cwt. 1qr. 27lb. 4oz. 7d.
(6) 1051 lb. 2 oz. 4 dwt. 12 g. (7) 6
(8) 504 (9) 9*l.* 19*s.* 5¾*d.*
(10) $77\frac{11}{30}$ (11) 1⅓ (12) 47⅔

4 (1) 410030010 (2) 29581422
(3) 1711290 (4) 3 lb. 10 oz. 2 dr. 0 s. 6 g.
(5) 171072 (6) 3540
(7) 689 m. 3 f. 32 p. 5 yd. 1 ft. 6 in.

Sec.

4 (8) 42 t. 11 3wt. 0 qr. 16 lb. 10 oz. 6 dr.
(9) 7 (10) 1008
(11) $94\frac{3}{8}$ (12) $2\frac{27}{44}$
(13) $64\frac{9}{10}$

5 (1) Three thousand four hundred and fifty millions, six hundred and seven thousand, five hundred and forty-one.
(2) 608460072 (3) 98m. 1f. 12p. 4y. 0ft. 11in.
(4) 110080 (5) 85375
(6) 45 a. 1 r. 33 p. $0\frac{1}{4}$ yd. (7) 2 a. 2 r. 13 p. 26 yd. 4 ft.
(8) 6 (9) 1727936
(10) $76\frac{13}{30}$ (11) $7\frac{13}{178}$
(12) $81\frac{3}{8}$

6 (1) 204104049 (2) 5052275801712
(3) 50078 (4) 3 a. 1 r. 29 p. 17 yds. 7 ft.
(5) 42526 (6) 3a. 2r. 32p. 28y. 2ft. 36in.
(7) 15106l. 2 q. 1 b. 2 p. (8) 7 dy. 0 hr. 34 min. 24 sec.
(9) 4 (10) 168168
(11) $14\frac{17}{48}$ (12) $12\frac{33}{35}$
(13) $47\frac{13}{48}$

7 (1) Seven thousand and forty millions, six hundred thousand, seven hundred and fifty-one.
(2) 974462400 (3) 567843
(4) 517 a. 1 r. 28 p. 27 yd. (5) 18537313
(6) 52 tons 8 cwt. 2 qrs. 26 lbs. 12 oz. 14 dr.
(7) 52960d. 2h. 53m. 35s. (8) 1 r. 5 p. 27 sq. yd.
(9) 3
(10) A = 6 times; B = 7 times; C = 8 times; D = 9 times.
(11) $54\frac{44}{45}$ (12) $9\frac{7}{27}$
(13) $66\frac{1}{13}$

8 (1) 6004,709,005 (2) 14383068455
(3) $25153\frac{601}{1231}$ (4) 2981086
(5) 28 lb. (6) 65 m. 6 f. 147 yd. 2 ft.
(7) 36 a. 2 r. 1 p. $18\frac{3}{4}$ yd. (8) 4415*l.* 16*s.* $8\frac{1}{4}$*d.*
(9) 34 (10) 7
(11) 2464 (12) 252 dy. 36 28 21
(13) $22\frac{33}{35}$ (14) $13\frac{1}{2}$
(15) $94\frac{3}{8}$

Sec.

9 (1) Five thousand and ninety millions, sixty-seven thousand, three hundred and forty-five.
(2) 61033280 (3) 37485678
(4) 313764 (5) 7 lb. 10 oz. 3 dr. 2 sc. 19 g.
(6) 31*l.* 10*s.* 0$\frac{1}{4}$*d.* (7) 127 a. 0 r. 34 p. 1 yd.
(8) 102 a. 3 r. 6 p. 10$\frac{1}{2}$ yd. (9) 3 t. 4 cwt. 2 qr. 24 lb. 3 oz.
(10) 19 (11) 24232824
(12) 25$\frac{2}{3}$ (13) 15$\frac{74}{83}$
(14) 77

10 (1) 204003052 (2) 46708081516
(3) 506708 (4) 5 y. 3 m. 3 w. 6 d. 23 h.
(5) 403672 (6) 8 lb. 6 oz. 1 dwt. 16 gr.
(7) 12 t. 0 cwt. 3 qr. 7 lb. 13$\frac{1}{3}$ oz.
(8) 3304 t. 11 cwt. 0 qr. 10 lb. 9 oz. 4 dr.
(9) 314*l.* 17*s.* 6$\frac{3}{4}$*d.* (10) 9
(11) 8928 hours. (12) 16$\frac{41}{60}$
(13) 18$\frac{3}{4}$ (14) 44$\frac{11}{15}$

11 (1) Fifty thousand and sixty-seven millions, four hundred and fifty-six. (2) 1052328
(3) 506784 (4) 17696
(5) 22693 (6) 9 l. 4 q. 7 b. 2 p.
(7) 4797 loads. (8) 5 sq.yd. 7 ft. 132 in. nearly.
(9) 56 (10) 6
(11) $\frac{1}{2}$ way round and $\frac{1}{4}$ way round ; 132, 96, 48, 66, 33, 32.
(12) 26$\frac{23}{30}$ (13) 23$\frac{13}{22}$
(14) 50$\frac{7}{30}$

12 (1) 5004103084 (2) 1052328
(3) 50675 (4) 34403
(5) 9 t. 18 cwt. 0 qr. 5 lb. 13 oz. 1 dr.
(6) 19901 lb. 6 oz. 6 dwts. 8 gr.
(7) 178 nearly. (8) 115 r. 17 qr. 15 sh.
(9) 8 (10) 2625
(11) 110$\frac{11}{18}$ (12) 26$\frac{31}{44}$
(13) 53$\frac{5}{13}$

PART THE SECOND.

ANSWERS TO "IMPROPER FRACTIONS TO MIXED NUMBERS."

Section.			
1	(1) $3\frac{1}{4}$	(2) $3\frac{3}{5}$	(3) $3\frac{3}{4}$
	(4) $17\frac{2}{7}$	(5) $28\frac{1}{2}$	(6) $18\frac{15}{17}$
	(7) 24	(8) $34\frac{5}{6}$	(9) $3\frac{111}{152}$
2	(10) $57\frac{1}{2}$	(11) $393\frac{1}{4}$	(12) $574\frac{1}{9}$
	(13) $29\frac{16}{19}$	(14) $54\frac{53}{153}$	(15) $160\frac{105}{107}$
	(16) $5\frac{505}{1567}$		
3	(17) $113\frac{2}{5}$	(18) $147\frac{5}{7}$	(19) $589\frac{1}{3}$
	(20) $57\frac{8}{15}$	(21) $298\frac{1}{17}$	(22) $56\frac{85}{142}$
	(23) $24\frac{79}{233}$	(24) $197\frac{113}{141}$	
4	(25) $1417\frac{3}{4}$	(26) $7558\frac{8}{11}$	(27) $4088\frac{1}{13}$
	(28) $4062\frac{3}{22}$	(29) $23756\frac{1}{5}$	(30) $147\frac{326}{567}$
5	(31) $473\frac{1}{6}$	(32) $269\frac{7}{31}$	(33) $214\frac{1}{19}$
	(34) $364\frac{5}{156}$	(35) $249\frac{97}{108}$	(36) $141\frac{359}{567}$
6	(37) $6416\frac{1}{13}$	(38) $1162\frac{30}{77}$	(39) $512\frac{79}{99}$
	(40) $125\frac{43}{536}$	(41) $274\frac{171}{304}$	(42) $82\frac{501}{931}$
7	(43) $1683\frac{3}{8}$	(44) $1233\frac{27}{43}$	(45) $1064\frac{9}{13}$
	(46) $559\frac{114}{167}$	(47) $161\frac{353}{513}$	(48) $2717\frac{413}{578}$

ANSWERS TO "MIXED NUMBERS TO IMPROPER FRACTIONS."

Section			
1	(1) $\frac{23}{4}$	(2) $\frac{25}{3}$	(3) $\frac{48}{5}$
	(4) $\frac{89}{12}$	(5) $\frac{113}{13}$	(6) $\frac{118}{15}$
	(7) $\frac{192}{21}$	(8) $\frac{192}{17}$	(9) $\frac{187}{15}$
2	(10) $\frac{235}{17}$	(11) $\frac{163}{29}$	(12) $\frac{374}{46}$
	(13) $\frac{337}{17}$	(14) $\frac{712}{29}$	(15) $\frac{491}{27}$
	(16) $\frac{2086}{77}$	(17) $\frac{3339}{104}$	
3	(18) $\frac{202}{13}$	(19) $\frac{183}{8}$	(20) $\frac{1616}{47}$
	(21) $\frac{1187}{9}$	(22) $\frac{2601}{19}$	(23) $\frac{3957}{17}$
	(24) $\frac{1357}{13}$		
4	(25) $\frac{721}{23}$	(26) $\frac{1222}{15}$	(27) $\frac{2276}{12}$
	(28) $\frac{4155}{13}$	(29) $\frac{5573}{11}$	(30) $\frac{91353}{11}$
	(31) $\frac{8786}{17}$		
5	(32) $\frac{511}{9}$	(33) $\frac{1619}{12}$	(34) $\frac{14752}{17}$
	(35) $\frac{2021}{19}$	(36) $\frac{9628}{19}$	(37) $\frac{16880}{21}$
	(38) $\frac{160459}{121}$		
6	(39) $\frac{2303}{22}$	(40) $\frac{3176}{27}$	(41) $\frac{14149}{104}$
	(42) $\frac{87589}{105}$	(43) $\frac{304518}{75}$	(44) $\frac{1136641}{132}$
	(45) $\frac{759303}{187}$		
7	(46) $\frac{4115}{13}$	(47) $\frac{235788}{29}$	(48) $\frac{80504}{156}$
	(49) $\frac{1813057}{223}$	(50) $\frac{3405886}{673}$	(51) $\frac{2611471}{324}$

ANSWERS TO "FRACTIONS TO THEIR LOWEST TERMS."

Section.

1 (1) $\frac{3}{8}$ (2) $\frac{6}{7}$ (3) $\frac{11}{12}$
(4) $\frac{13}{17}$ (5) $\frac{3}{4}$ (6) $\frac{4}{7}$
(7) $\frac{5}{9}$ (8) $\frac{4}{9}$

2 (9) $\frac{23}{32}$ (10) $\frac{4}{3}$ (11) $\frac{5}{4}$
(12) $\frac{6}{7}$ (13) $\frac{7}{9}$ (14) $\frac{18}{11}$
(15) $\frac{13}{19}$

3 (16) $\frac{8}{7}$ (17) $\frac{9}{5}$ (18) $\frac{11}{17}$
(19) $\frac{7}{19}$ (20) $\frac{6}{23}$ (21) $\frac{8}{15}$
(22) $\frac{3}{17}$

4 (23) $\frac{13}{14}$ (24) $\frac{8}{9}$ (25) $\frac{15}{16}$
(26) $\frac{12}{13}$ (27) $\frac{8}{7}$ (28) $\frac{32}{35}$
(29) $\frac{17}{21}$

5 (30) $\frac{15}{19}$ (31) $\frac{19}{23}$ (32) $\frac{5}{17}$
(33) $\frac{15}{17}$ (34) $\frac{3}{28}$ (35) $\frac{2}{27}$
(36) $\frac{4}{35}$

ANSWERS TO ADDITION AND SUBTRACTION OF FRACTIONS.

Section			
1	(1) $\frac{53}{65}$	(2) $1\frac{1}{21}$	(3) $1\frac{4}{11}$
	(4) $5\frac{5}{6}$	(5) $\frac{109}{240}$	(6) $1\frac{5}{78}$
2	(7) $\frac{26}{35}$	(8) $\frac{34}{63}$	(9) $\frac{86}{91}$
	(10) $\frac{61}{117}$	(11) $\frac{181}{255}$	(12) $\frac{106}{285}$
3	(13) $\frac{8}{35}$	(14) $\frac{85}{78}$	(15) $\frac{14}{39}$
	(16) $\frac{18}{35}$	(17) $\frac{139}{165}$	(18) $\frac{3}{184}$
4	(19) $\frac{2}{315}$	(20) $\frac{53}{276}$	(21) $\frac{187}{672}$
	(22) $\frac{35}{156}$	(23) $\frac{1}{9}$	(24) $\frac{178}{1378}$
5	(25) $1\frac{13}{42}$	(26) $\frac{449}{540}$	(27) $\frac{29}{60}$
	(28) $\frac{5}{9}$	(29) $1\frac{43}{105}$	(30) $2\frac{2}{117}$
6	(31) $\frac{37}{120}$	(32) $\frac{31}{84}$	(33) $\frac{5}{7}$
	(34) $\frac{61}{65}$	(35) $\frac{47}{125}$	(36) $\frac{53}{252}$
7	(37) $\frac{13}{20}$	(38) $3\frac{2}{9}$	(39) $\frac{4}{21}$
	(40) $\frac{9}{14}$	(41) $\frac{6585}{15984}$	(42) $\frac{41}{160}$
8	(43) $\frac{1}{4}$	(44) $\frac{1}{6}$	(45) $1\frac{97}{120}$
	(46) $8\frac{11}{28}$	(47) $2\frac{3}{16}$	(48) $\frac{47}{84}$

Section			
9	(49) $5\frac{1}{5}$	(50) $\frac{3}{16}$	(51) $1\frac{1}{4}$
	(52) $3\frac{19}{24}$	(53) $1\frac{3}{35}$	(54) $\frac{75}{81}$
10	(55) $\frac{7}{9}$	(56) $\frac{731}{975}$	(57) $\frac{259}{360}$
	(58) $\frac{2}{5}$	(59) $\frac{121}{216}$	(60) $3\frac{17}{60}$
11	(61) $7\frac{1}{27}$	(62) $11\frac{7}{18}$	(63) $16\frac{3}{10}$
	(64) $23\frac{3}{4}$	(65) $5\frac{193}{840}$	(66) $33\frac{1}{6}$
12	(67) $12\frac{80}{99}$	(68) $57\frac{1}{4}$	(69) $39\frac{3}{4}$
	(70) $5\frac{1}{8}$	(71) $21\frac{1}{5}$	(72) $1\frac{11}{16}$
13	(73) $2\frac{215}{533}$	(74) $2\frac{10917}{11284}$	(75) $1\frac{137}{156}$
	(76) $1\frac{1049}{1394}$	(77) $1\frac{1}{6}$	(78) $3\frac{13}{75}$

Find the value of $\cfrac{4}{5 + \cfrac{1}{6 + \cfrac{1}{7 + \frac{1}{8}}}}$

Here, $$\cfrac{4}{5 + \cfrac{1}{6 + \cfrac{1}{7 + \frac{1}{8}}}} = \cfrac{4}{5 + \cfrac{1}{6 + \frac{8}{57}}} = \cfrac{4}{5 + \frac{57}{350}} = \frac{1400}{1807}$$

Fractions of this kind are called *continued fractions.*

If the small fraction $\frac{1}{8}$ be omitted, then the fraction becomes

$$\cfrac{4}{5 + \cfrac{1}{6 + \frac{1}{7}}} = \cfrac{4}{5 + \frac{7}{43}} = \frac{172}{222}$$

Omit $\frac{1}{7}$ from this fraction, then $\cfrac{4}{5 + \frac{1}{6}} = \frac{24}{31}$. Omit $\frac{1}{6}$, then the fraction becomes $\frac{4}{5}$.

The fractions $\frac{4}{5}$, $\frac{24}{31}$, $\frac{172}{222}$, are called convergents, and of all fractions, in less terms, they approach so near to the true value of $\frac{1400}{1807}$, that it is impossible to approach nearer without employing fractions with greater terms.

To find the continued fraction corresponding to $\frac{197}{107}$.

```
107)197(1
    107
    ---
     90)107(1
         90
        ---
         17)90(5
            85
            --
             5)17(3
               15
               --
                2)5(2
                  4
                  -
                  1)2(2
                    2
                    -
                    0
```

This is exactly the same operation as finding the greatest common measure.

The quotients 1, 1, 5, 3, 2, 2, are formed into the continued fractions as follows:—

$$1 + \cfrac{1}{1 + \cfrac{1}{5 + \cfrac{1}{3 + \cfrac{1}{2 + \frac{1}{2}}}}}$$

The process of which is obvious. The converging fractions are

$$\frac{11}{6} \qquad \frac{35}{19} \qquad \frac{81}{44}$$

and obtained by omitting one term in succession.

14 (79) $3\frac{1}{4}$ (80) $\frac{513}{850}$ (81) $6\frac{793}{999}$

(82) $1\frac{5201}{6070}$ (83) $3\frac{7}{36}$ (84) $1\frac{5}{8}$

15 (85) $2\frac{215}{533}$ (86) $2\frac{10917}{11284}$ (87) $1\frac{137}{156}$

(88) $1\frac{1321}{1394}$ (89) $1\frac{18}{301}$ (90) $\frac{45}{158}$

ANSWERS TO MULTIPLICATION AND DIVISION OF FRACTIONS.

Section.			
1	(1) $\frac{12}{95}$	(2) $\frac{7}{20}$	(3) $\frac{5}{28}$
	(4) $\frac{1}{5}$	(5) $\frac{1}{10}$	(6) $\frac{9}{128}$
	(7) $\frac{18}{145}$	(8) $\frac{2}{5}$	(9) $\frac{289}{392}$
	(10) $\frac{1}{7}$	(11) $\frac{3}{8}$	(12) $\frac{1}{36}$
2	(13) 1	(14) $1\frac{1}{2}$	(15) $1\frac{1}{2}$
	(16) $1\frac{4}{5}$	(17) 7	(18) $\frac{2}{3}$

(See Example 1, page 113.)

	(19) $\frac{7}{10}$	(20) $1\frac{5}{7}$	(21) 1
	(22) $\frac{1}{2}$	(23) $\frac{13}{14}$	(24) 7
3	(25) $\frac{31}{39}$	(26) $\frac{10}{17}$	(27) $\frac{231}{452}$
	(28) $\frac{3}{4}$	(29) $3\frac{3}{26}$	(30) $9\frac{4}{5}$
4	(31) $\frac{32}{189}$	(32) 3	(33) $1\frac{1}{3}$
	(34) $\frac{3}{5}$	(35) $12\frac{1}{2}$	(36) $2\frac{3}{4}$
5	(37) $\frac{4}{78}$	(38) $\frac{15}{56}$	(39) 3
	(40) $\frac{2}{51}$	(41) $57\frac{3}{4}$	(42) 1
	(43) $1\frac{4}{5}$	(44) $\frac{1}{3}$	(45) $2\frac{3}{4}$
	(46) $\frac{3}{7}$	(47) $1\frac{20}{21}$	(48) $\frac{2}{5}$

Divide $\dfrac{7\,(1\frac{1}{2}\text{ of }\frac{3}{14})}{\frac{1}{6}\left(\dfrac{3}{3\frac{1}{2}}\text{of }7\right)}$ by $\dfrac{9}{14}$; $\left\{\begin{matrix}\text{and find the}\\ \text{value of}\end{matrix}\right\}\dfrac{\frac{1}{2}+\frac{1}{3}+\frac{1}{4}}{\dfrac{1}{2\frac{1}{2}}+\dfrac{1}{3\frac{1}{2}}+\dfrac{1}{4\frac{1}{2}}}$

(From Colenso's Arithmetic.)

First,

$$\frac{7\,(1\frac{1}{2}\text{ of }\frac{3}{14})}{\frac{1}{6}\left(\dfrac{3}{3\frac{1}{2}}\text{of }7\right)}\div\frac{9}{14}=\frac{7\times\frac{3}{2}\times\frac{3}{14}}{\frac{1}{\cancel{6}}\times\frac{\cancel{6}}{\cancel{7}}\times\cancel{7}}\times\frac{14}{9}=\frac{7\times\cancel{9}\times\cancel{14}}{2\times\cancel{14}\times\cancel{9}}=3\tfrac{1}{2}$$

Again,
$$\frac{\frac{1}{2}+\frac{1}{3}+\frac{1}{4}}{\dfrac{1}{2\frac{1}{2}}+\dfrac{1}{3\frac{1}{2}}+\dfrac{1}{4\frac{1}{2}}}=\frac{\dfrac{6+4+3}{12}}{\frac{2}{5}+\frac{2}{7}+\frac{2}{9}}\,.$$

$$=\frac{\dfrac{13}{12}}{\dfrac{24}{35}+\dfrac{2}{9}}$$

$$=\frac{\dfrac{13}{12}}{\dfrac{216+70}{35\times9}}$$

$$=\frac{\cancel{13}\times35\times\overset{3}{\cancel{9}}}{\underset{4}{\cancel{12}}\times\underset{22}{\cancel{286}}}$$

$$=\frac{105}{88}$$

$$=1\tfrac{17}{88}.$$

The rule to divide one fraction by another is to invert the divisor, and then multiply. The explanation of this is simple, for instance, divide $\dfrac{\left(\frac{8}{11}\right)}{\left(\frac{4}{5}\right)}=\dfrac{8}{\left(\frac{11\times4}{5}\right)}=\dfrac{8\times5}{11\times4}=\dfrac{8}{11}\times\dfrac{5}{4}$, or the divisor inverted.

Each operation depends upon the property, which cannot be too strongly impressed upon the mind of the student, that the value of a fraction is not altered by multiplying the numerator and denominator by the same quantity.

Section.			
7	(49) 161	(50) 1	(51) 9
	(52) $\frac{2}{3}$	(53) $4\frac{16}{45}$	(54) $2\frac{86}{207}$
8	(55) $2\frac{26}{27}$	(56) $1\frac{3}{7}$	(57) $3\frac{4}{9}$
	(58) $\frac{170}{231}$	(59) $1\frac{5}{48}$	(60) $2\frac{71}{140}$
9	(61) $1\frac{17}{18}$	(62) $1\frac{1}{4}$	
10	(63) $\frac{731}{755}$	(64) $\frac{378}{713}$	
11	(65) $\frac{1007}{3229}$	(66) $\frac{18}{95}$	
12	(67) $\frac{2795}{12213}$	(68) $1\frac{113}{532}$	
13	(69) $\frac{3591}{19952}$	(70) $\frac{12}{57}$	
14	(71) $1\frac{17}{25}$	(72) $\frac{1}{153}$	
15	(73) $3\frac{479}{504}$	(74) $3\frac{1}{10}$	
16	(75) $1\frac{43}{110}$	(76) $\frac{743}{840}$	
17	(77) $\frac{113}{693}$	(78) $\frac{9}{10}$ is the greatest $\frac{247}{280}$	
	(79) $3\frac{3}{50}$	(80) $1\frac{2}{3}$	

ANSWERS TO EXAMPLES ON DIFFERENT UNITS OF MEASURE.

See Examples 2 and 3, pages 113 and 114.

Sec.		
1	(1) 12*s.* 0*d.*	(2) 2*s.* $9\frac{3}{4}$*d.*
	(3) 7*s.* $7\frac{3}{7}$*d.*	(4) 1*l.* 5*s.* 10*d.*
	(5) 4*s.* $3\frac{3}{7}$*d.*	(6) 7*s.* $7\frac{7}{11}$*d.*
2	(7) $\frac{3}{100}$.	(8) $\frac{1}{420}$.
	(9) $\frac{5}{14}$.	(10) $\frac{20}{49}$.
	(11) $\frac{7}{15}$.	(12) $\frac{3}{7}$.
3	(13) 23*l.* 10*s.* $7\frac{1}{17}$*d.*	(14) 58*l.* 18*s.* $2\frac{1}{4}$*d.*
	(15) 1*s.* $3\frac{3}{7}$*d.*	(16) 43*l.* 15*s.*
	(17) 1*l.* 1*s.* $7\frac{4}{39}$*d.*	(18) 11*s.* $9\frac{3}{4}$*d.*
4	(19) $\frac{7}{40}$.	(20) $\frac{69}{160}$.
	(21) $\frac{31}{42}$.	(22) $\frac{1}{40}$.
	(23) $\frac{2}{5}$.	(24) $\frac{5}{32}$.
5	(25) 12 cwt.	(26) 4 lb. 15 oz. $10\frac{14}{45}$ dr.
	(27) 18 cwt. 2 qr. 7 lb. 8 oz.	
	(28) 3 t. 4 cwt. 1 qr. 21 lb. 12 oz. $7\frac{1}{3}$ dr.	
	(29) 6*l.* 15*s.* $9\frac{1}{4}\frac{7}{19}$*d.*	
	(30) 3 cwt. 1 qr. 2 lb. 8 oz. $11\frac{7}{11}$ dr.	
6	(31) $\frac{13}{4480}$.	(32) $\frac{1}{100}$.
	(33) $\frac{1}{140}$.	(34) $\frac{9}{84}$.
	(35) $\frac{4299}{17920}$.	(36) $\frac{1551}{1792}$.
7	(37) 8 m. 5 f. 110 yd.	(38) 2 m. 1 f. 24 y. 2 ft. $7\frac{7}{23}$ in.
	(39) 3 m. 6 f. 48 y. 1 ft. $3\frac{3}{7}$ in.	(40) 9 yd. 0 ft. $0\frac{9}{35}$ in.
8	(41) 9 m. 6 f. 41 yd. 2 ft.	(42) 18 yd. 1 ft. $4\frac{4}{5}$ in.
	(43) $\frac{2}{5}$.	(44) $\frac{7}{20}$.
9	(45) $\frac{5}{84}$.	(46) $\frac{2}{825}$.
	(47) $\frac{3}{16}$.	(48) $2\frac{1}{3}$.
	(49) $\frac{7}{81}$	(50) $\frac{3}{70}$.
10	(51) 1 r. 34 p. 20 yd. 1 ft. 72 in.	(52) 1 a. 0 r. 27 p. $6\frac{1}{20}$ yd.
	(53) 1 r. 9 p. 6 yd. 8 ft. $119\frac{1}{13}$ in.	
	(54) 7 a. 0 r. 10 p. 20 y. 1 ft. 72 in.	

Sec.				
11	(55)	2 a. 2 r. 20 p. 12 yd.	(56)	1 r. 11 p. 28$\frac{1133}{1440}$ yd.
12	(57)	$\frac{1}{28}$.	(58)	$\frac{2}{15}$.
	(59)	$\frac{6}{121}$.	(60)	$\frac{13}{400}$.
	(61)	$\frac{3}{128}$.	(62)	$\frac{1}{36}$.
13	(63)	19 ft. 493$\frac{5}{7}$ in.	(64)	1 yd. 20 ft. 432 in.
	(65)	1 ft. 1044 in.	(66)	1 y. 15 ft. 99$\frac{2}{13}$ in.
14	(67)	21 ft. 112 in.	(68)	2 yd. 8 ft. 1123$\frac{1}{3}$ in.
15	(69)	$\frac{1}{8}$.	(70)	$\frac{1}{27}$.
	(71)	$\frac{1}{144}$.	(72)	$\frac{1}{80}$.
	(73)	$\frac{1}{4}$.	(74)	$\frac{1}{324}$.

Standard gold being coined at the rate of 3*l.* 17*s.* 10½*d.* per oz., what is the least integral number of ounces that can be coined into an integral number of sovereigns? (*Cambridge examination papers.*)

3*l.* 17*s.* 10½*d.* $= \frac{623}{160}$. Therefore, 160 is the least number of ozs.

16	(75)	1 lb: 0 oz. 2 dwt. 13$\frac{87}{95}$ gr.	(76)	1 lb. 10 oz. 16 dwt. 16 gr.
	(77)	3 lb. 8 oz. 16 dwt. 19$\frac{1}{5}$ gr.	(78)	5 lb. 2 oz. 15 dwt. 9$\frac{3}{13}$ gr.
17	(79)	4lb. 4oz. 14dwt. 17$\frac{18}{133}$gr.	(80)	2 lb. 0 oz. 18 dwt. 12 gr.
18	(81)	$\frac{1}{75}$.	(82)	$\frac{1}{160}$.
	(83)	$\frac{25}{108}$.	(84)	$\frac{1}{16}$.
19	(85)	$\frac{3}{320}$.	(86)	$\frac{1}{20}$.
	(87)	$\frac{1}{11}$.	(88)	$\frac{3}{19}$.
20	(89)	6 y. 4 m. 1 w. 2$\frac{1}{3}$d.	(90)	5 y. 6 m. 3 w. 5$\frac{2}{13}$d.
	(91)	6 d. 9 h. 36 min.	(92)	2 w. 6 d. 5 h. 20 min.
21	(93)	2m. 3w. 0d. 11h. 23m. 4s.	(94)	5y. 6m. 1w. 5d. 14h. 24m.
22	(95)	$\frac{15}{104}$.	(96)	$\frac{1}{78}$.
	(99)	$\frac{1}{24}$.	(100)	$\frac{1}{63}$.
	(101)	$\frac{1}{15}$.	(102)	$\frac{1}{21}$.
23	(103)	1 lb. 7 oz. 3 d. 8 gr.	(104)	19cwt. 1qr. 10lb. 3oz. 3$\frac{1}{3}$d.
	(105)	1 lb. 6 oz. 7 dwt. 4$\frac{1}{2}$ gr.	(106)	4 f. 36 p. 2 y. 1 ft. 4 in.
24	(107)	$\frac{7}{960}$.	(108)	$\frac{1}{30}$.
	(109)	4.	(110)	32.
	(111)	$\frac{1}{16}$.	(112)	$\frac{1}{9}$.
25	(113)	62*l.* 8*s.*	(114)	2*l.* 2*s.* 7$\frac{1}{3}$*d.*
26	(115)	1 t. 5 cwt. 2 qr. 24 lb.	(116)	15$\frac{1}{2}$ tons.
27	(117)	$\frac{1651}{38640}$.	(118)	$\frac{2}{7}$.
28	(119)	$\frac{163}{38528}$.	(120)	$\frac{2}{11}$.
29	(121)	3m. 7f. 189yd. 0ft. 7$\frac{1}{3}$in.	(122)	1 m. 5 fur. 40 yd.

Sec.

30 (123) $\frac{3}{11}$. (124) $\frac{5}{8}$.

(125) $\frac{2}{3}$. (126) $\frac{1}{3}$.

31 (127) 6*s.* $5\frac{1}{4}\frac{3}{5}$*d.* (128) 16*s.* $4\frac{1}{2}$*d.*

(129) $\frac{1}{30}$. (130) $\frac{1}{42}$.

(131) $\frac{1}{8}$. (132) $\frac{1}{16}$.

32 (133) 4*l.* 7*s.* 6*d.* (134) 1 r. 37 p. 16 y. 2 ft. $85\frac{1}{13}$ in.

(135) $\frac{1}{24}$. (136) $\frac{1}{5}$.

(137) $\frac{2}{495}$.

33 (138) 9 a. 1 r. $28\frac{4}{7}$ p. (139) 2 a. 3 r. 33 p.

(140) $\frac{2}{27}$. (141) $\frac{5}{84}$.

34 (142) 14 ft. 1080 in. (143) 1 yd. 7 ft. $91\frac{162}{245}$.

35 (144) 1 dwt. $4\frac{4}{5}$ gr. (145) 61 lb. 10 oz. 11 dwt. $4\frac{4}{5}$ gr.

36 (146) 2 y. 6 m. 2 w. (147) 5 d. 23 h. 44 m.

37 (148) 1*l.* 9*s.* $7\frac{1}{2}$*d.* (149) 7*l.* 13*s.*

38 (150) $\frac{13}{36}$. (151) $\frac{11}{12}$.

(152) $\frac{5}{88}$. (153) $\frac{13}{270}$.

(154) 10*s.* 6*d.* (155) $\frac{379}{756}$.

(156) 2 t. 14 cwt. 0 qr. 18 lb. 10 oz. $10\frac{2}{3}$ dr.

ANSWERS TO DECIMAL FRACTIONS.

Sec.

1 (1) .333 (2) ·266

(3) 19.25 (4) 2·2

(5) 15·166 (6) 17·15789

(7) ·35714 (8) ·46

(9) 1.166 (10) ·78125

(11) 1.7619 (12) ·8823

2 (13) 18·75 (14) 124·866

(15) 104·1515 (16) 98·7142

(17) 33·3125 (18) 22·5

3 (19) $\frac{29}{200}$ (20) $\frac{9}{20}$

(21) $\frac{49}{8}$ (22) $9\frac{33}{200}$

(23) $10\frac{33}{250}$ (24) $12\frac{29}{40}$

(25) $\frac{3}{20}$ (26) $1\frac{3}{4}$

(27) $3\frac{17}{20}$ (28) $1\frac{23}{40}$

(29) $\frac{3}{500}$ (30) $\frac{3}{2500}$

See Example 4, page 114.

Sec.
4 (31) ·9 (32) ·16352
(33) 25·5 (34) 3·18
(35) 4·7142 (36) ·5151
5 (37) 4·04761 (38) 13·125
(39) 1·65 (40) ·3968
(41) ·08
6 (42) 1·65 (43) 1·2512
(44) ·416 (45) ·64285

ANSWERS TO ADDITION AND SUBTRACTION OF DECIMALS.

In the Addition and Subtraction of Decimals it is necessary to keep the decimal points under each other.

Sec.
1 (1) 50·9571 (2) 4·4507322 (3) 358·822467
(4) 94·98322 (5) 52·83623 (6) 821·9433
2 (7) 58·68173 (8) 3·23712 (9) 137·16836
3 (10) ·974503 (11) 995·2732 (12) 66·1815

ANSWERS TO MULTIPLICATION AND DIVISION OF DECIMALS.

In the Division of Decimals it is advantageous to reduce the divisor, if a decimal, to a whole number, which can be readily done by inspection. Thus ·045 divided by ·0052, is exactly the same as 450 divided by 52. The explanation of this is simple and depends upon the principle, which cannot be too familar to the student of fractions, that multiplying or dividing the numerator and denominator of a fraction by the same number does not alter its value.

Sec.
1 (1) 722·7822 (2) 10883·07968 (3) 1·503225
(4) ·05986728 (5) 523·977984 (6) 9·685599
2 (7) ·045 (8) ·0056 (9) ·000356
(10) ·001456 (11) 52·34 (12) ·0345

Sec.			
3	(13) ·05678	(14) 23·45	(15) ·567
	(16) 4·967	(17) 423	(18) 23.456
4	(19) 5·9498	(20) ·00567	(21) 62·8
	(22) 4·2523	(23) 33·7939	(24) 5000
5	(25) 400000	(26) 300000	(27) 3333333·3
	(28) ·004305	(29) ·01581	(30) 70·1492
6	(31) 65·9259	(32) 3·4406	(33) ·04067
		See Example 5, page 114.	
	(34) ·0000563	(35) ·2675	(36) 67
7	(37) 4·601	(38) ·5236	(39) 4·62
8	(40) 26·46144	(41) 5·57158	(42) 4·601
9	(43) 5·704	(44) ·06834	
10	(45) 2·715	(46) 1·457	(47) 1·2141

CIRCULATING DECIMALS.

Every vulgar fraction has not a corresponding finite decimal.

Thus, $\frac{1}{3} = \cdot 3333$ to infinity, $\frac{1}{7} = \cdot\dot{1}42857\dot{1}4285\dot{7}$, &c., to infinity.

In the first fraction the decimal is continually repeated, but in the second the figures are different between 1 and 7. Decimals of this kind are called *circulating* decimals.

In order to change these decimals into their corresponding vulgar fractions, the *numerator is composed of the circulating period, and the denominator of as many 9's as there are figures in the circulating period.*

$$\cdot\dot{1}4285\dot{7} = \frac{142857}{999999} = \frac{1}{7}. \text{ And, } \cdot 00\dot{6}7\dot{5} = \frac{1}{100} \times \frac{675}{999} = \frac{675}{99900} = \frac{1}{148}$$

$$5\cdot 193\dot{1}\dot{8} = \frac{1}{1000} \times 5193\frac{18}{99} = \frac{1}{1000} \times 5193\frac{2}{11} = 5\frac{193\frac{2}{11}}{1000} = 5\frac{2125}{11000} = 5\frac{17}{88}.$$

$$1\cdot 0\dot{4}2857\dot{1} = \frac{1}{10}\left(10\frac{428571}{999999}\right) = 1\frac{428571}{9999990} = 1\frac{3}{70}.$$

The reason of multiplying by 1000 and dividing by 1000 is to reduce the decimal $5\cdot 193\dot{1}\dot{8}$ to $5193\cdot\dot{1}\dot{8}$.

c* 2

ANSWERS TO EXAMPLES ON DIFFERENT UNITS OF MEASURE IN DECIMALS.

See Example 7, pages 115 and 116.

Sec.		
1	(1) 12*s.* 10$\frac{3}{4}$*d.*	(2) 16*s.* 10$\frac{3}{4}$*d.*
	(3) 1*l.* 10*s.* 11$\frac{3}{4}$*d.*	(4) 8*l.* 10*s.* 10$\frac{1}{4}$*d.*
	(5) 3*l.* 12*s.* 6$\frac{3}{4}$*d.*	(6) 1*l.* 3*s.* 4$\frac{1}{2}$*d.*
	(7) 10$\frac{1}{4}$*d.*	
2	(8) 1*l.* 0*s.* 2$\frac{1}{16}$*d.*	(9) 1*l.* 17*s.* 2$\frac{1}{4}$*d.*
	(10) 2*l.* 14*s.* 8$\frac{1}{4}$*d.*	(11) 17*s.* 5$\frac{1}{4}$*d.*
	(12) 11*s.* 8$\frac{1}{2}$*d.*	(13) 7*l.* 3*s.* 8$\frac{1}{2}$*d.*
3	(14) ·2625	(15) ·2738
	(16) ·6093	(17) ·6677
	(18) ·6625	(19) 1·2239
	(20) 3·1319	(21) ·1388
4	(22) ·3174	(23) ·5555
	(24) 4·3864	(25) ·8125 and ·0406
	(26) ·11801	(27) ·02417
	(28) ·87708	
5	(29) 7 cwt. 2 qr. 20 lb. 2$\frac{14}{25}$ oz.	(30) 1 t. 9 cwt. 0 q. 13 lb. 7$\frac{1}{25}$ oz.
	(31) 17 lb. 7 oz. 8 dr.	(32) 5 t. 0 c. 2 qr. 20 lb. 2$\frac{14}{25}$ oz.
	(33) 2 cwt. 3 qr. 7 lb. 13$\frac{11}{25}$ oz.	(34) 1 qr. 8 lb. 5$\frac{79}{125}$ oz.
	(35) 5 lb. 12 oz. 4$\frac{444}{625}$ dr.	
6	(36) ·8	(37) ·83839
	(38) 1·29677	(39) ·033778
	(40) 5·6435	
7	(41) 1 m. 2 f. 30 p. 2$\frac{1}{5}$ yd.	(42) 5 yd. 1 ft. 11$\frac{11}{50}$ in.
	(43) 10$\frac{1}{2}$ in.	(44) 17 yd. 0 ft. 6$\frac{8}{125}$ in.
	(45) 1 m. 4 f. 27 p.	(46) 2 yd. 1 ft. 10$\frac{7}{50}$ in.
8	(47) ·8125	(48) 1·6818
	(49) 5·9722	(50) 2·52083 and ·84027
	(51) 1·03235	(52) ·73546
9	(53) 1 r. 15 p. 9 yd.	(54) 1 a. 1 r. 32 p. 29 yd.
	(55) 4 a. 1 r. 15 p. 6 yd.	(56) 21 p. 25 yd. 3$\frac{62}{100}$ ft.
	(57) 3 r. 19 p. 14 yd.	(58) 2 p. 10$\frac{1}{2}$ yd.
10	(59) ·0325	(60) ·0531
	(61) 5·721	(62) ·165
	(63) 1.208	(64) ·984

Sec.		
11	(65) 6 yd. 3 ft. 1581$\frac{3}{25}$ in.	(66) 3 yd. 2 ft. 1396$\frac{26}{125}$ in.
	(67) 3 yd. 17 ft. 1463$\frac{77}{125}$ in.	(68) 7 ft. 1680 in.
	(69) 1 ft. 1285 in.	(70) 73 in.
12	(71) ·12037	(72) ·0378
	(73) 1·2973	(74) 1·0356
	(75) 1·2169	(76) ·02668
13	(77) ·8	(78) ·067708
	(79) ·000347	(80) ·5555
	(81) ·230769	(82) ·3636
14	(83) 4 oz. 3 dwt. 0·96 gr.	(84) 1 lb. 8 oz. 2 dwt. 17·28 gr.
	(85) 1 lb. 0 oz. 11 dwt. 16·32 gr.	(86) 3 oz. 18 dwt. 8·4 gr.
	(87) 5 lb. 7 oz. 7 dwt. 23 gr.	(88) 6 lb. 11 oz. 8 dwt. 13·7 gr.
	(89) 1 lb. 0 oz. 12 dwt. 9·87 gr.	
15	(90) ·06868	(91) ·034616
	(92) ·172668	(93) ·001016
	(94) .27777	(95) ·5
16	(96) 1 d. 14 h. 9·37 m.	(97) 3 m. 3 d. 22 h. 8·8 m.
	(98) 9 y. 11 m. 0 w. 3 d. 11 h.	(99) 4 d. 5 h. 35 m.
	(100) 67 y. 6 m. 2 w.	(101) 20 h. 24·115 m.
	(102) ·5625	

ANSWERS TO QUESTIONS IN DECIMAL COINAGE.

Sec.			
1	(1) ·916	(2) ·787	(3) ·858
	(4) ·575	(5) ·962	(6) ·67
2	(7) ·462	(8) ·466	(9) ·870
	(10) ·929	(11) ·783	(12) ·704
3	(13) ·781	(14) ·669	(15) ·276
	(16) ·764	(17) ·164	(18) ·281
4	(19) ·463	(20) ·766	(21) ·562
	(22) ·687	(23) ·220	(24) ·431
5	(25) ·913	(26) ·769	(27) ·039
	(28) ·523	(29) ·944	(30) ·668
6	(31) ·282	(32) ·690	(33) ·748
	(34) ·332	(35) ·706	(36) ·981

Sec.						
7	(37)	·168	(38)	·223	(39)	·877
	(40)	·693	(41)	·578	(42)	·414
8	(43)	·742	(44)	·182	(45)	·278
	(46)	·063	(47)	·125	(48)	·168
9	(49)	·375	(50)	·666	(51)	·875
	(52)	·316	(53)	·166	(54)	·287
10	(55)	·785	(56)	·277	(57)	·264
	(58)	·666	(59)	·085	(60)	·616

ANWERS TO QUESTIONS IN DECIMAL COINAGE.

Sec.		£	s.	d.		£	s.	d.
1	(1)	0	15	8 ·16	(2)	0	6	3¼·44
	(3)	0	8	7½·72	(4)	0	18	3½·4
	(5)	0	14	0¾·84	(6)	0	16	8 ·16
	(7)	0	10	2¾·52				
2	(8)	0	11	4¼·088	(9)	0	8	1¼·376
	(10)	0	6	11¼·12	(11)	0	18	4½·952
	(12)	0	16	2 ·184	(13)	0	6	0¼·344
	(14)	0	16	1½·432				
3	(15)	0	2	9¾·936	(16)	3	3	1½·432
	(17)	5	2	8¾·328	(18)	0	2	0¾·84
	(19)	0	6	9¾·36	(20)	0	10	1¼·76
	(21)	0	15	8½·176				
4	(22)	18	11	4¼·088	(23)	5	6	1 ·104
	(24)	9	6	3½·016	(25)	0	18	11 ·04
	(26)	0	2	1½·72	(27)	0	4	0¾·84
	(28)	0	11	4 ·2				
5	(29)	1	10	1½·432	(30)	1	16	0 ·014
	(31)	4	0	11 ·208	(32)	0	0	6 ·24
	(33)	0	0	1½·72	(34)	1	0	1½·72
	(35)	0	16	9½·688				
6	(36)	42	0	1½·432	(37)	8	0	9¾·072
	(38)	3	2	1 ·104	(39)	0	2	5½·464
	(40)	0	8	7½·816	(41)	0	11	4¼·088
	(42)	0	17	6¼·44				

Sec.		£	s.	d.		£	s.	d.
7	(43)	8	14	1 ·1208	(44)	7	8	1¼·088
	(45)	1	0	11¼·984	(46)	0	11	11 ·208
	(47)	0	15	4½·72	(48)	0	12	9½·496
	(49)	0	15	2¼·6				
8	(50)	13	2	7½·048	(51)	14	2	9¾·8112
	(52)	2	13	4 ·224	(53)	0	17	9½·304
	(54)	0	19	11½·848	(55)	0	15	6¼·632
	(56)	0	15	4 ·248				

PROPORTION.

Ratio is a mutual relation of two magnitudes of the same kind, the comparison being made by considering one of the magnitudes to be divided by the other. Thus, the ratio of 12 to 3 is equal to 4 ; and the ratio of 21 to 7 is equal to 3. It is evident then, that the two terms of a ratio form a fraction, the lowest terms of which is the ratio required. The ratio of 8 to 36 is equal to $\frac{8}{36} = \frac{2}{9}$. The numerator of the fraction is called the *antecedent*, and the denominator the *consequent* of the ratio.

Proportional numbers.—When two ratios are equal, the four numbers are called proportional.

Direct and Inverse Proportion.—The cost of provisions and labour are in direct proportion to their quantity, while the time of consumption is inversely proportional to the number of men employed to consume them.

If 17 men will do 3 pieces of work in 35 days, in what time will 119 men do 7½ such pieces of work ?

In this question the number of days is the object of enquiry.

$$35 = \text{days in which 17 men can do 3 pieces of work.}$$

$$\frac{35 \times 17}{119} = \text{days in which 119 men can do 3 pieces of work.}$$

$$\frac{35 \times 17 \times 7\frac{1}{2}}{3 \times 119} = \text{days in which 119 men can do } 7\tfrac{1}{2} \text{ pieces of work.}$$

$$= 12\tfrac{1}{2} \text{ days.}$$

In each line from the first there are two operations denoted, as it is better to indicate the whole of the operations to be performed in order to see which of them will cancel. The first line is given by the question; the second and third are obtained by the following reasoning:—

It will take 1 man 17 times as long to do the work as it will take 17 men, then 17 is a multiplier; but 119 men will do the work in $\frac{1}{119}$ part the time that 1 man will do it, then 119 is a divisor, &c.

Ten excavators can dig out 12 loads of earth in 16 hours, whilst 12 other common excavators, less powerful than the former, dig out only 9 loads in 15 hours; it is required to find the time they will conjointly dig out 100 loads. (*Encyclopædia Metropolitana.* Art. Arithmetic.)

$$12 = \text{loads that 10 excavators dig in 16 hours.}$$

$$\frac{12}{16} = \text{loads that 10 excavators dig in 1 hour.}$$

Again,

$$9 = \text{loads that 12 common excavators dig in 15 hours.}$$

$$\frac{9}{15} = \text{loads that 12 common excavators dig in 1 hour.}$$

Hence,

$$\frac{12}{16} + \frac{9}{15} = \frac{27}{20} = \text{the loads that the men conjointly dig in 1 hour.}$$

$$1 = \text{hours that the men conjointly dig } \frac{27}{20} \text{ loads.}$$

$$\frac{20}{27} = \text{hours that the men conjointly dig 1 load.}$$

$$\frac{20 \times 100}{27} = \text{hours that the men conjointly dig 100 loads.}$$

$$= 74\tfrac{2}{27} \text{ hours.}$$

Six eggs are worth 10 danari, and 12 danari are worth 4 thrushes, and 5 thrushes are worth 3 quails, and 8 quails are worth 4 pigeons, and 9 pigeons are worth 2 capons, and 6 capons are worth a staro of wheat; how many eggs are worth 4 staro of wheat? *(Encyclopædia Metropolitana.)*

$$6 \text{ eggs} = 10 \text{ danari.}$$

$$\frac{6 \times 12}{10} \text{ eggs} = 12 \text{ danari} = 4 \text{ thrushes.}$$

$$\frac{6 \times 12 \times 5}{10 \times 4} \text{ eggs} = 5 \text{ thrushes} = 3 \text{ quails.}$$

$$\frac{6 \times 12 \times 5 \times 8}{10 \times 4 \times 3} \text{ eggs} = 8 \text{ quails} = 4 \text{ pigeons.}$$

$$\frac{6 \times 12 \times 5 \times 8 \times 9}{10 \times 4 \times 3 \times 4} \text{ eggs} = 9 \text{ pigeons} = 2 \text{ capons.}$$

$$\frac{6 \times 12 \times 5 \times 8 \times 9 \times 6}{10 \times 4 \times 3 \times 4 \times 2} \text{ eggs} = 6 \text{ capons} = 1 \text{ staro of wheat.}$$

$$\frac{6 \times 12 \times 5 \times 8 \times 9 \times 6 \times 4}{10 \times 4 \times 3 \times 4 \times 2} \text{ eggs} = 648 \text{ eggs} = 4 \text{ staro of wheat.}$$

This and the following question are frequently solved by the *Chain Rule*, which is nothing more than a series of equations similar to the above.

Suppose the direct exchange between Amsterdam and Paris to be 51 Flemish pence for 3 francs, and that a Paris merchant remits to his agent at Amsterdam 13,000 francs, sending them first to London at 24 francs per £ sterling, thence to Rome at 65 pence per crown, thence to Venice at 100 crowns for 145 ducats, thence to Leghorn at 105 ducats for 100 pezze, and thence to Amsterdam at 84 Flemish pence per pezza; how many Flemish pence will the merchant gain by sending circularly instead of direct?

Flemish Pence.

$$84 = 1 \text{ pezza.}$$

$$84 \times 100 = 100 \text{ pezze} = 105 \text{ ducats.}$$

$$\frac{84 \times 100 \times 145}{105} = 145 \text{ ducats} = 100 \text{ crowns at Venice.}$$

$$\frac{84 \times 100 \times 145}{105 \times 100} = 1 \text{ crown at Venice} = 65 \text{ English pence.}$$

$$\frac{84 \times 100 \times 145 \times 240}{105 \times 100 \times 65} = 1l. \text{ sterling} = 24 \text{ francs.}$$

Then, $\frac{84 \times 100 \times 145 \times 240 \times 13000}{105 \times 100 \times 65 \times 24} = 232000$ Flemish pence = 13000 francs by means of the circular exchange.

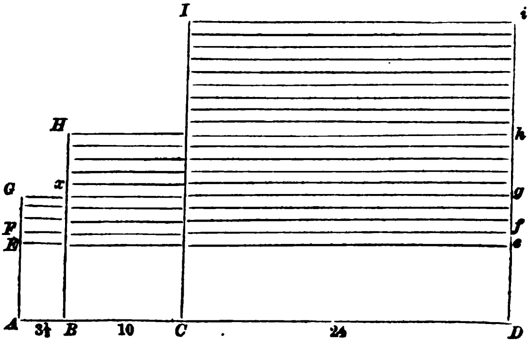
Again, if the 13000 francs had been remitted by the direct exchange, we should have,

$$51 \text{ Flemish pence} = 3 \text{ francs.}$$

$$\frac{51 \times 13000}{3} \text{ Flemish pence} = 221000 \text{ Flemish pence.}$$

Therefore, 232000 — 221000 = 11000 Flemish pence = $647\frac{1}{17}$ francs which are gained by the circular exchange.

If 12 oxen eat up 3⅓ acres of pasture in 4 weeks, and 21 oxen eat up 10 acres of like pasture in 9 weeks, to find how many oxen will eat up 24 acres in 18 weeks, supposing the grass to grow uniformly.—*(From Sir I. Newton's "Universal Arithmetic," page* 80.)



Let the breadths of the three pastures be a unit, then their lengths will be $AB = 3\frac{1}{3}$, $BC = 10$, and $CD = 24$.

Also, let Ee be the height of the grass in each pasture when the oxen commence to eat; and EF the height which the grass grows per week. Then it is evident from the question that GA, HB, IC will be the height of the grass at the end of 4 weeks, 9 weeks, and 18 weeks respectively, and which must be eaten by 12 oxen, 21 oxen, and a certain number of oxen to be found in 4 weeks, 9 weeks, and 18 weeks respectively. As it is readily seen that the pasture AB grows 4 weeks, the pasture BC grows 9 weeks, and the pasture CD grows 24 weeks.

$12 =$ oxen that can eat $3\frac{1}{3} = \frac{10}{3}$ $\left\{\right.$ acres, in the pasture AB, whose height is AG, in 4 weeks.

$\frac{12 \times 3 \times 4}{10} = \left\{\right.$ oxen that can eat 1 acre in a similar pasture in 1 week. (*a*)

$\frac{12 \times 3 \times 4 \times 24}{10 \times 18} = 19\frac{1}{5} = \left\{\right.$ oxen that can eat 24 acres, or the pasture CD to the height Dg in 18 weeks.

Besides this, there is obviously the growth of 14 weeks, on each of the 24 acres in the pasture CD, to be eaten by a certain number of oxen in 18 weeks.

Again, since, $\frac{12 \times 3 \times 4}{10} = \left\{\right.$ oxen that can eat 1 acre, in a similar pasture, in 1 week (see *a*),

Then, $\frac{12 \times 3 \times 4 \times 10}{10 \times 9} = 16 = \left\{\right.$ oxen that can eat 10 acres, in the pasture BC, whose height is AG, in 9 weeks.

But, $21 = \left\{\right.$ oxen that can eat 10 acres, in the pasture BC, whose height is BH, in 9 weeks.

Therefore, $5 = \left\{\right.$ oxen that can eat 10 acres, in the pasture BC, whose height is $xH = 5$, in 9 weeks.

$\frac{5 \times 14}{5} = \left\{\right.$ oxen that can eat 10 acres, in the pasture BC, whose height is $Ig = 14$, in 9 weeks.

$\frac{5 \times 14 \times 24}{5 \times 10} = \left\{\right.$ oxen that can eat 24 acres, in the pasture CD, whose height is $ig = 14$, in 9 weeks.

$\frac{5 \times 14 \times 24 \times 9}{5 \times 10 \times 18} = \left\{\right.$ oxen that can eat 24 acres, in the pasture CD, whose height is $ig = 14$, in 18 weeks.

$= 16\frac{4}{5}$.

Hence, $19\frac{1}{5} + 16\frac{4}{5} = 36$ oxen, the number required.

If 6 oxen, or 10 colts, can eat up 21 acres of pasture in 14 weeks, and 10 oxen and 6 colts can eat up 45 acres of a similar pasture in 20 weeks, the grass growing uniformly, how many sheep will eat up 240 acres in 40 weeks, admitting that 1134 sheep can eat the same quantity as 12 oxen and 22 colts.—(*From Keith's Arithmetic, page* 74.)

$$1134 \text{ sheep} = 12 \text{ oxen} + 22 \text{ colts} = 20 \text{ colts} + 22 \text{ colts} = 42 \text{ colts}.$$

$$\text{Therefore, } 27 \text{ sheep} = 1 \text{ colt.}$$

$$\text{And, } 270 \text{ sheep} = 10 \text{ colts.}$$

$$\text{Again, } 6 \text{ colts} + 10 \text{ oxen} = 6 \text{ colts} +$$

$$\frac{50}{3} \text{ colts} = \frac{68}{3} \text{ colts} = \frac{68}{3} \times 27 \text{ sheep} = 612 \text{ sheep.}$$

This reduces the question to the following :—

If 270 sheep can eat up 21 acres of pasture in 14 weeks, and 612 sheep can eat up 45 acres of a similar pasture in 20 weeks, the grass growing uniformly, how many sheep will eat up 240 acres in 40 weeks ?—*Answer*, 3472 sheep.

ANSWERS TO QUESTIONS IN PROPORTION.

Sec.

1 (1) 4 (2) 63 (3) 37*l.* 16*s.* (4) 32

2 (5) 8 d. 21 h. (6) 8 mth. (7) 360 (8) 297*l.*

3 (9) 6 (10) 15 mth. (11) 9*d.*

4 (13) 12 oz. (14) 6 mth. (15) 847*l.* (16) 105*l.* & 1*l.* 5*s.*

5 (17) 19*l.* 5*s.* (18) 42*l.* 10*s.* (19) 45*l.* 7*s.* $2\frac{1}{4}$ $\frac{3}{5}$*d.*

6 (20) 2 men. (21) $1\frac{2}{3}$

(22) 14 months and 24 men. (23) $9\frac{1}{11}$

7 (24) $4\frac{1}{2}$ weeks. (25) 2 men and $1\frac{1}{18}$ day.

(26) 132*l.* and $58\frac{2}{3}$ bushels.

8 (27) 396*l.*, $333\frac{1}{3}$ acres, and 3*l.* (28) 5*l.* 4*s.* and $3\frac{3}{7}$*d.*

(29) 6 months and 1 man.

See Page 119, where Question 11 Section 10, Miscellaneous Examples, is worked in full.

9 (30) $3\frac{1}{3}$ months and 41 men.

(31) 56 months, and 1008 months, and 70 men.

(32) $328\frac{1}{3}$ lb.

Sec.

10 (33) $1\frac{8}{11}$ weeks. (34) 30 men.
(35) 27 months.

11 (36) 36 tons. (37) 105 tons.
(38) 38 tons. (39) 10*l.* 14*s.* $3\frac{1}{4}$*d.*
(40) 4*s.* 1*d.*

12 (41) $3\frac{1}{2}$ sq. in. ; 60 tons. (42) 427*l.* 1*s.* 8*d.* ; 10*l.* 16*s.*
(43) 257*l.* 2*s.* $10\frac{3}{7}$*d.*, 72*l.* (44) $9\frac{3}{4}$*d.*

13 (45) $12\frac{4}{9}$ oz. ; $10\frac{2}{3}$ months. (46) $14\frac{2}{5}$ weeks ; 9 hours.
(47) 144 square yards.

14 (48) $4\frac{6}{13}$ oz. ; 4*s.* $7\frac{5}{13}$*d.* (49) 147*l.* ; 84 men,
(50) 81.

15 (51) 321*l.* (52) 6702*l.* 7*s.* $4\frac{3}{4}$*d.*
(53) 955*l.* 11*s.* $8\frac{3}{4}$*d.*

16 (54) 7 months ; 53 men. (55) 15 men ; 9 days.
(56) $77\frac{1}{2}$ months ; 135 men ; 10 days.

(The latter part of this question should read,—how many men will do it in 31 weeks working 10 days per week ? how many days per week must 279 men work to do it in 15 weeks ?)

7 (57) $1\frac{89}{189}$ weeks ; 1014 pecks. (58) 26 men ; $8\frac{3}{4}$ months.

18 (59) 10 men ; $22\frac{19}{20}$ hours. (60) $7\frac{17}{21}$ months ; 68 men.

19 (61) 10 months. (62) $62\frac{19}{63}$ days.
(63) $2\frac{19}{23}$ hours.

20 (64) $12\frac{34}{45}$ months. (65) $42\frac{6}{7}$.
(66) $123\frac{33}{53}$.

21 (67) $133\frac{1}{3}$ days. (68) $1\frac{7}{8}$ hours.
(69) 1*l.* 8*s.* $4\frac{1}{3}$*d.*

22 (70) 18. (71) 10 horses.
(72) 50 men.

23 (73) 160 men. (74) 3200 ; 2240 men.
(75) 300 sacks.

24 (76) $1333\frac{1}{3}$ men. (77) 84 miles.
(78) $203\frac{11}{63}$ vol.

25 (79) $207\frac{11}{27}$. (80) $20\frac{4}{7}$
(81) $1\frac{11}{23}$ months.

Sec.

26 (82) $4\frac{71}{540}$ months ; 69 men. (83) $30\frac{11}{18}$ hours.

Three workmen can do a piece of work in a certain time, viz.: *A* once in three weeks, *B* thrice in 8 weeks, and *C* five times in 12 weeks. It is desired to know in what time they can finish it jointly ?—*Sir I. Newton's Universal Arithmetic.*

It is convenient to represent the work performed by unity.

$\frac{1}{3}$ = the part of the work done by A in one week.

$\frac{3}{8}$ = the part of the work done by B in one week.

$\frac{5}{12}$ = the part of the work done by C in one week.

Then, $\frac{1}{3} + \frac{3}{8} = \frac{5}{12} + \frac{9}{8}$ = part of the work done by $A + B + C$ in 1 week.

Therefore, $1 + \frac{9}{8} = \frac{8}{9}$ weeks, the time in which the work will be finished jointly.

I have employed 5 people *A*, *B*, *C*, *D*, and *E*, upon a piece of work. Now, I am told that *A*, *B*, *C*, and *D* can finish it in 13 days ; *A*, *B*, *C*, and *E*, in 15 days ; *A*, *B*, *D*, and *E*, in 12 days ; *A*, *C*, *D*, and *E*, in 19 days ; and *B*, *C*, *D*, and *E*, in 14 days. Pray in what time may I reasonably expect to have my work done by their all working together ; and, suppose I should wish to discharge four of them, which of them would finish the work soonest, when left to himself ?—(*Keith's Arithmetic, page* 96.)

It is convenient in questions of this sort to represent the work performed by *unity*.

Then,

$\frac{1}{13}$ = the part of the work done by $A+B+C+D$ in 1 day. (1.)

$\frac{1}{15}$ = the part of the work done by $A+B+C+E$ in 1 day. (2.)

$\frac{1}{12}$ = the part of the work done by $A+B+D+E$ in 1 day. (3.)

$\frac{1}{19}$ = the part of the work done by $A+C+D+E$ in 1 day. (4.)

$\frac{1}{14}$ = the part of the work done by $B+C+D+E$ in 1 day. (5.)

By adding equations (1), (2), &c., together and dividing by 4, there results,

$$\frac{1}{4}\left(\frac{1}{13}+\frac{1}{15}+\frac{1}{12}+\frac{1}{19}+\frac{1}{14}\right) = \left\{\begin{array}{l}\text{the part of the work done by}\\ A+B+C+D+E \text{ per day.}\end{array}\right. \quad (6.)$$

$$= \frac{12137}{138320}.$$

$$\text{Hence, } 1 \div \frac{12137}{138320} = \frac{138320}{12137}\text{ days} = 11\frac{4813}{12137}\left\{\begin{array}{c}\text{days in com-}\\ \text{pleting the}\\ \text{work.}\end{array}\right.$$

Subtract each of the equations (1), (2), (3), (4), (5), from (6), and the remainders will be the part of the work done by *E*, *D*, *C*, *B*, and *A* respectively. It is readily seen that *B* will do the greatest portion of work per day.

A will do the work in $61\frac{643}{2257}$ days ; *B* in $28\frac{2324}{4857}$ days ; *C* in $226\frac{1154}{1881}$ days ; *D* in $47\frac{3851}{8747}$ days ; and *E* in $92\frac{596}{1497}$ days.

Sec.

27 (84) $8\frac{2}{11}$. (85) 42.

(86) $16\frac{1}{5}$.

28 (87) $3\frac{27}{47}$. (88) A=24 ; B=$33\frac{3}{5}$; C=$18\frac{2}{5}$.

29 (89) $57\frac{2}{13}$. (90) $3\frac{3}{7}$.

(91) $18\frac{17}{18}$.

A cistern can be filled by two pipes, *A* and *B*, in four minutes and five minutes respectively, and emptied by *C* in $2\frac{2}{5}$ minutes ; *A* is opened for 2 minutes, and then *A* and *B* together for 1 minute more, when *C* is also opened ; in what time would the cistern, which now contains 361 gallons, be full ? and how many gallons would have passed through *A* and *B* respectively ? — (*From Colenso's Arithmetic, page* 127.)

$\frac{1}{4}$ = the part of the cistern filled by *A* per minute,

$\frac{1}{5}$ = the part of the cistern filled by *B* per minute.

$\frac{5}{12}$ = the part of the cistern emptied by *C* per minnte.

Then, $\frac{2}{4} + \frac{1}{4} + \frac{1}{5} = \frac{19}{20}$ = the part of the cistern filled by *A* and *B* before *C* is opened.

But, $\frac{19}{20}$ of the cistern is 361 gallons ; therefore the whole cistern is 380 gallons.

$\frac{1}{4} + \frac{1}{5} - \frac{5}{12} = \frac{1}{30}$ = the part of the cistern filled by *A* and *B* when *C* is opened.

$\frac{1}{20} \div \frac{1}{30} = 1\frac{1}{2}$ minute the time of filling $\frac{1}{20}$ part of the cistern.

It is evident that *A* is opened $4\frac{1}{2}$ minutes, and *B* is opened $2\frac{1}{2}$ minutes.

Then, $\frac{380 \times 9}{4 \times 2} = 427\frac{1}{2}$ gallons passed through the pipe *A*.

$\frac{380 \times 5}{5 \times 2} = 190$ gallons passed through the pipe *B*.

Sec.

30 (92) 45 minutes. (93) 28.

(94) B = 18$\frac{6}{13}$; A = 14$\frac{2}{17}$; C = 34$\frac{2}{7}$.

31 (95) 36 days. (96) 300 days.

(97) 8 hours ; 30 miles from Portsmouth.

32 (98) 34 m. 24 s. past 10 o'clock ; 15$\frac{12}{17}$ from London.

(99) 54 m. 32$\frac{8}{11}$ s. after 9 o'clock ; 70 miles from London ; 15$\frac{65}{88}$ miles asunder.

ANSWERS TO QUESTIONS IN INTEREST.

Sec.		£	s.	d.		£	s.	d.
1	(1)	15	0	0	(2)	36	0	0
	(3)	78	15	0	(4)	183	15	0
2	(5)	171	12	0	(6)	31	3	5¼
	(7)	67	13	7¼	(8)	95	1	3

When the discount on a bill is 5 per cent. its amount in shillings is equal to the bill in pounds. Thus, the discount on £456 at 5 per cent. is 456 shillings = £22 16s.

What has to be paid on a bill of £327 18*s.* 7¾*d.* at 3¾ per cent. ?

£	*s.*	*d.*
327	18	7¾
		3
983	15	11¼
163	19	3¾
81	19	7¾
12,29	14	10¾
20		
5,94		
12		
11,38		
4		
1,55		

Hence, £12 5*s.* 11¼*d.* is the discount.

£	*s.*	*d.*	
327	18	7¾	
12	5	11¼	
315	12	8½	amount to be paid.

Sec.		£	s.	d.		£	s.	d.
3	(9)	5	5	0	(10)	11	5	0
	(11)	14	12	6	(12)	151	4	0
	(13)	40	7	6				
4	(14)	43	18	10¼	(15)	297	17	5¼
	(16)	206	2	6¼	(17)	215	14	3½
5	(18)	15	15	0	(19)	14	15	9
	(20)	17	14	6	(21)	12	19	3½
	(22)	10	7	0	(23)	15	13	8
6	(24)	1704	14	7½	(25)	26	12	4½
	(26)	7057	8	3½	(27)	48	7	5¼
7	(28)	41	10	9¾	(29)	3781	6	0¼
	(30)	2287	12	11	(31)	969	1	7¼
	(32)	962	10	0	(33)	981	2	3½
8	(34)	2	10	3	(35)	384	7	6
	(36)	8	11	3½	(37)	30	0	7¼
	(38)	2	18	9½				
9	(39)	8	2	10	(40)	288	14	3¼
	(41)	470	1	1½	(42)	385	5	5½
	(43)	172	15	0¼	(44)	2001	13	8½
10	(45)	596	1	2¾	(46)	10	6	11
	(47)	84	13	5	(48)	459	10	8½
	(49)	856	4	1¼	(50)	3	13	8
11	(51)	348	15	4¼	(52)	158	15	5¼
	(53)	206	4	6¼	(54)	242	2	4¾
	(55)	53	19	1	(56)	1067	1	10½

What principal will produce an interest of £134 10*s.* in 3½ years at 4¾ per cent. per annum?

100 = the principal that produces an interest of 4¾*l.* per annum.

$$\frac{100}{3\frac{1}{2}} = \text{the principal that produces an interst of } 4\tfrac{3}{4}l. \text{ in } 3\tfrac{1}{2} \text{ years.}$$

$$\therefore \frac{100 \times 134\frac{1}{2}}{3\frac{1}{2} \times 4\frac{3}{4}} = \begin{cases} \text{the principal that produces an interest of } 134l.\ 10s. \\ \text{in } 3\tfrac{1}{2} \text{ years.} \end{cases}$$

$$= 809l.\ 0s.\ 5\tfrac{1}{2}d.$$

Sec.		£	s.	d.		£	s.	d.
12	(57)	83	1	8	(58)	750	0	0
	(59)	2631	1	5				
13	(60)	500	0	0	(61)	483	6	8
	(62)	520	0	0	(63)	700	0	0
14	(64)	666	13	4	(65)	500	0	0
	(66)	1073	17	9¼				
15	(67)	1280	0	0	(68)	380	19	0½
	(69)	1400	0	0				
16	(70)	294	3	4	(71)	10769	4	7½

In what time will 370*l.* produce an interest of 34*l.* 5*s.* at 4½ per cent. per annum ?

$$1 = \text{years that } 100l. \text{ produce an interest of } 4\tfrac{1}{2}l.$$

$$\tfrac{2}{9} = \text{years that } 100l. \text{ produce an interest of } 1l.$$

$$\frac{2 \times 34\frac{1}{4}}{9} = \text{years that } 100l. \text{ produce an interest of } 34\tfrac{1}{4}l.$$

$$\frac{2 \times 34\frac{1}{4} \times 100}{9 \times 370} = \text{years that } 370l. \text{ produce an interest of } 34\tfrac{1}{4}l.$$

$$= 2\tfrac{19}{333} \text{ years.}$$

In what time will the principal 1340*l.* 10*s.* 6*d.* amount to 1657*l.* 4*s.* $5\frac{3}{4}\cdot\frac{7}{100}$*d.* at 4½ per cent. per annum ?

$$\begin{array}{lrrl} & \pounds & s. & d. \\ \text{First,} & 1657 & 4 & 5\frac{3}{4}\cdot\frac{7}{100} \\ & 1340 & 10 & 6 \\ \hline & 316 & 13 & 11\frac{3}{4}\cdot\frac{7}{100} \end{array} = \left\{\begin{array}{l}\text{interest to be gained at} \\ \quad 4\frac{1}{2} \text{ per cent.}\end{array}\right.$$

$$1 = \text{years that the principal } 100l. \text{ will gain } 4\tfrac{1}{2}l.$$

$$\tfrac{2}{9} = \text{years that the principal } 100l. \text{ will gain } 1l.$$

$$\frac{2 \times (\overset{\pounds}{316}\ \overset{s.}{13}\ \overset{d.}{11\frac{3}{4}\cdot\frac{7}{100}})}{9} = \text{years that } \overset{\pounds}{100} \text{ will gain } \overset{\pounds}{316}\ \overset{s.}{13}\ \overset{d.}{11\tfrac{3}{4}\cdot\tfrac{7}{100}}$$

$$\frac{2 \times 100 \left(\overset{\pounds}{316}\ \overset{s.}{13}\ \overset{d.}{11\frac{3}{4}\cdot\frac{7}{100}}\right)}{9 \times (1340\ \ 10\ \ 6)} = \left\{ \begin{array}{l} \text{years that } \overset{\pounds}{1340}\ \ \overset{s.}{10}\ \ \overset{d.}{6} \\ \text{will gain } \ 316\ \ 13\ \ 11\frac{3}{4}\cdot\frac{7}{100} \end{array} \right.$$

$$= \frac{200 \times 30403107}{9 \times 128690400}$$

$$= 5\tfrac{1}{4} \text{ years.}$$

Sec.

16 (72) 3333*l.* 6*s.* 8*d.*

17 (73) $1\frac{8}{27}$ years. (74) $6\frac{146}{233}$ months.
(75) 3 m. 1 w. 6 d. (76) $9\frac{41}{91}$ years.

18 (77) $7\frac{17621}{56797}$ years. (78) $6\frac{98}{3027}$ years.
(79) $33\frac{1}{3}$ years. (80) $57\frac{1}{7}$ years.

19 (81) $22\frac{2}{9}$ years. (82) $18\frac{2}{11}$ years.
(83) $2\frac{18}{91}$ years. (84) $36\frac{524}{4281}$ years.

The principal, 784*l.* 10*s.* 8*d.*, amounts to 942*l.* 18*s.* $2\frac{16}{25}$*d.* in $4\frac{1}{4}$ years; find the rate per cent.

$$\begin{array}{lrrl} & \pounds & s. & d. \\ \text{First,} & 942 & 18 & 2\frac{16}{25} \\ & 784 & 10 & 8 \\ \hline & 158 & 7 & 6\frac{16}{25} = \text{the gain in } 4\tfrac{1}{4} \text{ years.} \end{array}$$

$$\overset{\pounds}{158}\ \ \overset{s.}{7}\ \ \overset{d.}{6\tfrac{16}{25}} = \text{the interest of } \overset{\pounds}{784}\ \ \overset{s.}{10}\ \ \overset{d.}{8} \text{ in } 4\tfrac{1}{4} \text{ years.}$$

$$\frac{4\ \left(\overset{\pounds}{158}\ \ \overset{s.}{7}\ \ \overset{d.}{6\frac{16}{25}}\right)}{17} = \text{the interest of } \overset{\pounds}{784}\ \ \overset{s.}{10}\ \ \overset{d.}{8} \text{ in 1 year.}$$

$$\frac{4 \times 100 \times \left(\overset{\pounds}{158}\ \ \overset{s.}{7}\ \ \overset{d.}{6\frac{16}{25}}\right)}{17 \times (784\ \ 10\ \ 8)} = \text{the interest of } 100l. \text{ in 1 year.}$$

$$= \frac{4 \times 100 \times 950266}{17 \times 4707200}$$

$$= 4\tfrac{3}{4} \text{ per cent.}$$

Sec.

20 (85) 5 (86) 3 (87) 4

21 (88) $4\frac{1}{2}$ (89) $3\frac{3}{4}$ (90) $2\frac{1}{2}$

22 (91) 4 (92) $3\frac{3}{4}$ (93) $4\frac{1}{4}$ (94) $3\frac{1}{4}$

The premium on a building is the interest of its value insured at a given rate per cent.

Sec.		£	s.	d.		£	s.	d.
23	(95)	10	14	10¼	(96)	126	9	8¼
	(97)	432	6	11¾				
24	(98)	73	16	9¾	(99)	27	14	9¾
	(100)	2947	15	1⅔	(101)	57	2	4¾
25	(102)	9	18	9¼	(103)	1	11	1
	(104)	2013	16	3½	(105)	7	0	10

What sum of money should be insured, and find the insurance, at 3½ per cent., on a building worth 1575*l.*, so that the owner may receive, in case the building is burnt, the value of the building, and premium or insurance ?

100 = the amount insured, that will insure a building worth £96½, together with the premium 3½*l.*

$$\frac{100 \times 1575}{96\frac{1}{2}} = \left\{ \begin{array}{l} \text{the amount insured, that will insure a} \\ \text{building worth 1575}l.\text{, together with the} \\ \text{premium.} \end{array} \right.$$

$$= 1632l.\ 2s.\ 5\tfrac{3}{4}d.$$

The insurance is = 1632*l.* 2*s.* 5¾*d.* — 1575*l.* = 57*l.* 2*s.* 5¾*d.*

Or the insurance is the interest of 1632*l.* 2*s.* 5¾*d.* at 3½ per cent.

The solution of the following questions depend upon similar principles to the above.

What is the amount of a bill which is 30*l.* after discount is deducted at 5½ per cent. ?

100 = the amount of a bill which is 94½*l.* after discount at 5½ per cent. is deducted.

$$\frac{100 \times 30}{94\frac{1}{2}} = \left\{ \begin{array}{l} \text{the amount of a bill which is 30}l.\text{ after discount} \\ \text{at 5½ per cent. is deducted.} \end{array} \right.$$

$$= 31l.\ 14s.\ 11\tfrac{1}{21}d.$$

(*a*) Find the amount of a bill which is 20*l.* after the discount is deducted at 7 per cent. 21*l.* 10*s.* 1¼*d.*

(*b*) Find the amount of a bill which is 34*l.* after the discount is deducted at 10 per cent. 37*l.* 15*s.* 6½ ⅔*d.*

(*c*) What is the amount of a bill which is 100*l.* after the discount is deducted at 9 per cent. ? 109*l.* 17*s.* $9\frac{1}{2}\cdot\frac{46}{91}$.

(*d*) What is the amount of a bill which is 345*l.* 7*s.* 8*d.* after the discount is deducted at 8½ per cent. ? 377*l.* 9*s.* 4¼*d.*

(*e*) What is the amount of a bill which is 1000*l.* after the discount is deducted at 16½ per cent. ? 1197*l.* 12*s.* $1\frac{25}{167}$*d.*

(*f*) Find the amount of a bill which is 3456*l.* 17*s.* 9*d.* after the discount is deducted at 22½ per cent. ; 4460*l.* 10*s.*

Sec.		£	*s.*	*d.*		£	*s.*	*d.*
26	(106)	11	11	4	(107)	40	3	6¾
	(108)	129	3	5½				
27	(109)	0	12	11½	(110)	15	5	3¼
	(111)	65	4	8¾				
28	(112)	142	8	5½	(113)	101	11	4¾

A sum is laid out in the 3 per cents. at 89⅜, and a half-year's dividend received upon it ; the stock being then sold at 94⅝, and the whole increase of capital being 54*l.*, find the original sum laid out.—From *Colenso's Arithmetic*, page 112.

If the stock is bought at 89⅜*l.* and sold at 94⅝*l.*, there is a gain of 5¼*l.* for a stock which has cost 89⅜*l.*

Besides this there is a gain of $\frac{3}{2}$*l.*, half a year's interest.

Hence, 89⅜ = the sum which has gained $5\frac{1}{4} + \frac{3}{2} = \frac{27}{4}l.$

$$\frac{89\frac{3}{8} \times 4}{27} = \text{the sum which gains } 1l.$$

$$\frac{89\frac{3}{8} \times 4 \times 54}{27} = \text{the sum which gains } 54l.$$

$$= 715l.$$

Sec.		£	*s.*	*d.*		£	*s.*	*d.*
28	(114)	0	14	9¼				
29	(115)	379	14	11¼	(116)	236	4	7½
	(117)	14	15	6¾	(118)	123	1	9¼

30 (119) 3*l.* 15*s.* 0*d.* loss.
(120) 4*l.* 18*s.* 3¼*d.* in favour of 4 per cents.
(121) 23*l.* 3*s.* 1¾*d.* in favour of 5 per cents.

Sec.
31 (122) 4s. 1d. per cent. in favour of 5 per cents.
(123) 21l. 9s. 7½d. in favour of 4½ per cents.
(124) 8l. 19s. 10d. in favour of 4½ per cents.
(125) 2l. 18s. 7¾d. in favour of 4 per cents.

32 (126) 265l. 19s. 1½·75d.
(127) 656l. 2s. 2½d.
(128) 811l. 1s. 3½d. lost 28l. 14s. 9½d.

33 (129) 13834l. 10s. 0d.
(130) 8548l. 3s. 5¼d.
(131) 11824l. 9s. 8¼d.

ANSWERS TO QUESTIONS IN COMPOUND INTEREST.

See Example 15, page 121.

Sec.
1 (1) 32l. 9s. 1d. (2) 189l. 11s. 5¼d.
(3) 744l. 11s. 5¾d.
2 (4) 397l. 0s. 10¼d. (5) 7065l. 17s. 0¼d.
3 (6) 341l. 19s. 2d. (7) 601l. 12s. 5½d.
4 (8) 1207l. 15s. 7¾d. (9) 373l. 2s. 10¼d.
5 (10) 3403l. 12s. 9½d. (11) 8642l. 16s. 10¼d.
6 (12) 1143l. 12s. 9d. (13) 3872l. 1s. 4½d.
(14) 383l. 1s. 9½d.

The following rule will give the amount of a principal at compound interest, for any number of payments at equal intervals; whether yearly, half-yearly, quarterly, &c.

1st.—*Find the amount of £1, at the first payment, by simple interest.*

2nd.—*Raise this amount to the power denoted by the number of payments.*

3rd.—*Multiply this power by the principal, and the product will be the amount.*

Find the amount of 150l. in a year, at 5 per cent. compound interest paid quarterly.

1st.—5 = the interest of 100l. for 1 year.

$$\frac{5}{4 \times 100} = \frac{1}{80} = \text{the interest of } 1l. \text{ for } \tfrac{1}{4} \text{ year.}$$

Then, $1\frac{1}{80}l.$ = the amount of 1*l.* for ¼ of a year.

Therefore, $150 \times \left(\frac{81}{80}\right)^4$ = 157*l.* 12*s.* 10*d.* the amount required.

If the payment be yearly, the amount will be 157*l.* 10*s.* 0*d.*

If the payment be ½ yearly, the amount will be 157*l.* 11*s.* 10½*d.*

If the payment be ¼ yearly, the amount will be 157*l.* 12*s.* 10*d.*

If the payment be monthly, the amount will be 157*l.* 13*s.* 5¾*d.*

If the payment be weekly, the amount will be 157*l.* 13*s.* 8¾*d.*

If compound interest was added every instant, the amount would never be greater than 157*l.* 13*s.* 9¾d : a result which is obtained by the following rule :—

1*st.*—*Raise* 2·7182818 *to the power indicated by the product of the interest of* 1*l. for a year, at the given rate per cent., and the number of years.*

2*nd.*—*Multiply this result by the principal, and the product will be the amount required.*

The number of years in which any sum of money will double itself, at compound interest, *may be found from the following Rule*:—

1*st.*—*Find the amount of* 1*l.* *in one year, at the given rate per cent., simple interest.*

2*nd.*—*Divide the log. of* 2 *by the log. of the above amount, and the* quotient will be the number of years required.

The following Table is calculated from this Rule.

Rate of Interest.	No. of years at which any sum of money will double itself at compound interest.
2	35·00278
2½	28·07103
3	23·44977
3½	20·14879
4	17·67298
4½	15·74730
5	14·20669
6	11·89566

The following rule will give the present value of a sum of money to be received certainly, at the end of a given number of years.

1st.—*Find the amount of* 1*l. in one year, at the given rate per cent., simple interest.*

2nd.—*Raise this amount to the power indicated by the number of years.*

3rd.—*Divide the sum of money to be received at the end of the given number of years by this power, and the quotient will be its present value.*

Find the present value of 500*l.* to be received at the end of 5 years, at 4 per cent. compound interest.

$$\text{Amount of } 1l. \text{ at 4 per cent.} = 1 + \frac{4}{100} = 1\frac{1}{25} = \frac{26}{25}l.$$

$$\text{The present value} = 500 \times \left(\frac{25}{26}\right)^5 = 410l.\ 19s.\ 3\tfrac{1}{4}d.$$

One of the most useful cases of interest is, when the principal is increased, not only by the interest, but also by some other sum at the same time.

To find the amount when the principal is added, at given equal intervals.

1.—Find the amount of 1*l.* at the end of the first interval at simple interest.

2.—Raise this amount to the power indicated by the number of equal payments at equal intervals, and subtract 1 from it.

3.—Take 1 from the amount of 1*l.*, as stated in the first part of the rule.

4.—Multiply 1, 2, and the principal together, and divide this product by the 3 ; the quotient will be the amount required.

Find the amount of 1*s.* paid weekly, at 5 per cent. per annum, compound interest, for 35 years.

1*s.* $= \frac{1}{20}l.$ the principal. And $52 \times 35 = 1820$ the intervals of adding the principal $\frac{1}{20}l.$

1. The amount of 1*l.* at the end of a week at 5 per cent. $\left.\right\} = 1\frac{1}{1040} = \frac{1041}{1040}$ *l.*

2. The power indicated by the number of payments less one $\left.\right\} = \left(\frac{1041}{1040}\right)^{1820} - 1.$

3. The amount of 1*l.* after deducting 1 $= \frac{1}{1040}$ *l.*

4. $\frac{1041}{1040} \times \left\{\left(\frac{1041}{1040}\right)^{1820} - 1\right\} \times \frac{1}{20} \div \frac{1}{1040} =$ 247*l.* 4*s.* 9*d.*

The operation cannot be conveniently performed without the aid of logarithms.

To find the present value of an annuity for a given number of years at a given rate per cent.

The present value must be such as to produce the same sum as the annuity at compound interest.

(1) Find the amount of 1*l.* at the end of a year at simple interest.

(2) Raise this amount to the power indicated, by the number of years for which the annuity has to be received.

(3) From unity take the reciprocal of the quantity in (2).

(4) From the amount of 1*l.* as stated in (1) take unity.

(5) Multiply the annuity by the amount in (3) and divide by the amount in (4).

What is the present value of an annuity of 120*l.*, which is continued 30 years, at 5 per cent. compound interest ?

By (1) The amount of 1*l.* at the end of a year $= \frac{21}{20}$ *l.*

(3) $1 - \left(\frac{20}{21}\right)^{30} =$ the value as indicated by 3.

(4) $\frac{1}{20} =$ the value as indicated by 4.

Then, $120 \times \left\{1 - \left(\frac{20}{21}\right)^{30}\right\} \div \frac{1}{20} = 2400\left\{1 - \left(\frac{20}{21}\right)^{30}\right\} =$ 1844*l.* 13*s.* 10¾*d.* nearly.

This operation is best performed by logarithms.

If the annuity is continued for ever, then its present value is found by dividing the annuity by the quantity indicated in (4), which is the interest of 1*l.* for one year at simple interest.

The present value of an annuity of 120*l.* for ever at 5 per cent.

$$= 120 \div \frac{1}{20} = 2400l.$$

If the annuity (say for 10 years) be in reversion, or not receivable till the end of 5 years, then the present value will be equal to the present value of the same annuity for 15 years, minus the present value of the same annuity for 5 years.

ANSWERS TO PROFIT AND LOSS.

An article is bought at 5*s.* 6*d.* per unit, and sold at 7*s.* 8*d.*; find the gain per cent.

$$7s.\ 8d. - 5s.\ 6d. = 2s.\ 2d. = \frac{13}{120}l. = \text{the gain on } 5s.\ 6d.$$

$$\text{Then, } \frac{13 \times 40 \times 100}{120 \times 11} = \text{the gain on } 100l.$$

$$= 39\frac{13}{33}l. \text{ per cent.}$$

See Example 16, page 122.

Sec.

1 (1) $11\frac{3}{17}$ (2) $13\frac{1}{3}$

(3) $4\frac{8}{23}$

2 (4) 1 (5) $4\frac{4}{7}$

(6) $15\frac{235}{1331}$

3 (7) $6\frac{2}{11}$ (8) $6\frac{2}{3}$

(9) $18\frac{2}{11}$ (10) $6\frac{2}{3}$

4 (11) 10*l.* (12) 10

(13) 4*l.* 15*s.* $2\frac{1}{2}$*d.*

5 (14) 20 (15) $8\frac{4}{7}$

(16) $12\frac{4}{23}$ (17) [illegible]

An article is bought at 2*l.* 3*s.* 6*d.* per unit; how must it be sold to realise a profit of 5½ per cent.?

$$105\tfrac{1}{2}l. = \text{the selling price of } 100l.$$

$$\frac{211}{2 \times 100} = \text{the selling price of } 1l.$$

$$\frac{211 \times 2l.\ 3s.\ 6d.}{2 \times 103} = \text{the selling price of } 2l.\ 3s.\ 6d.$$

$$= 2l.\ 5s.\ 10\tfrac{1}{2}\cdot\tfrac{4}{5}d.$$

Sold goods for 75*l.*, and by so doing lost 10 per cent., whereas in the regular course of trade I should have gained 30 per cent.; how much were they sold under their proper value? From *Colenso's Arithmetic.*

$$100 = \text{the cost price of the goods sold at } 90l.$$

$$\frac{100 \times 75}{90} = \text{the cost price of the goods sold at } 75l.$$

$$= \frac{250}{3} = 83\tfrac{1}{3}l.$$

Again,

$$30 = \text{the gain on } 100l.$$

$$\frac{30 \times 250}{100 \times 3} = \text{the gain on } 83\tfrac{1}{3}l.$$

$$= 25.$$

Therefore the goods should be sold for 83⅓*l.* + 25*l.* = 108⅓*l.*; but they were sold for 75*l.*, or 33⅓*l.* below their value.

Sec.

6 (18) 15*s.* 9*d.* (19) 23*s.* 6*d.*
(20) 38*s.* 6*d.* (21) 2*l.* 14*s.* 9*d.*

7 (22) 2*l.* 12*s.* [illegible] (23) 3*l.* 18*s.* 10*d.*
(24) 1*l.* 7*s.* $3\frac{21}{50}d.$ (25) 1*l.* 6*s.* 3*d.*

8 (26) 18*s.* 6[illegible]*d.* (27) [illegible]
(28) 16*s.* $6\frac{9}{50}d.$ (29) 16*s.* 6[illegible]*d.*

9 (30) 1*l.* 7*s.* $5\frac{4}{25}d.$ (31) 2*l.* 4*s.* 4[illegible]*d.*
(32) 5*l.* 9*s.* $2\frac{4}{25}d.$ (33) 6*l.* 18*s.* 0[illegible]*d.*

Sec.		
10	(34) 8*l.* 19*s.* $10\frac{1}{3}$*d.*	(35) 5*l.* 19*s.* $5\frac{3}{5}$*d.*
	(36) 4*l.* 7*s.* $11\frac{7}{10}$*d.*	(37) 5*l.* 9*s.* $8\frac{16}{23}$*d.*
11	(38) $4666\frac{2}{3}$ tons.	(39) $761\frac{13}{27}$ yards.
	(40) 10500 feet.	
12	(41) $3\frac{7}{11}$; 30000 tons.	(42) 12*l.* 17*s.* $3\frac{1}{2}$*d.* : $303\frac{1}{33}$ tons.
13	(43) 14*s.* $6\frac{78}{103}$*d.*	(44) 1*l.* 2*s.* $7\frac{37}{53}$*d.*
	(45) 2*s.* $2\frac{2}{3}$*d.*	
14	(46) 13*l.* 5*s.* $4\frac{176}{271}$*d.*	(47) 5*s.* $3\frac{189}{417}$*d.*
	(48) 13*l.* 19*s.* $6\frac{18}{33}$*d.*	
15	(49) $14\frac{2}{7}$*s.*	(50) $11\frac{1}{9}$*s.*
	(51) $22\frac{46}{57}$*l.*	(52) 20*s.* $10\frac{59}{311}$*d.*
	(53) 3*l.* 16*s.* 10*d.*	
16	(54) 24*l.* 2*s.* $3\frac{1}{3}$*d.*	(55) 2*s.* $3\frac{1}{4}$*d.*
	(56) 2*l.* 13*s.* $0\frac{3}{4}$*d.*	

ANSWERS TO QUESTIONS IN PRACTICE.

Sec.		£	*s.*	*d.*		£	*s.*	*d.*
1	(1)	29	5	0	(2)	7	10	6
	(3)	27	6	0	(4)	59	1	3
	(5)	202	13	4	(6)	349	6	3
	(7)	1724	10	8				
2	(8)	1002	9	0	(9)	96	6	8
	(10)	122	17	8	(11)	25	17	0
	(12)	39	13	0	(13)	151	11	6
	(14)	24	14	0				
3	(15)	12	0	8	(16)	64	6	1
	(17)	78	9	6	(18)	43	15	$10\frac{1}{3}$
	(19)	4	2	$0\frac{3}{4}$	(20)	1	4	$1\frac{1}{4}$
	(21)	1	2	$8\frac{1}{3}$				
4	(22)	240	8	6	(23)	1180	11	1
	(24)	1044	13	4	(25)	311	3	4
	(26)	486	13	4	(27)	1985	5	$7\frac{1}{3}$
	(28)	8	4	3				
5	(29)	56	15	$7\frac{1}{3}$	(30)	338	0	0
	(31)	3395	3	4	(32)	2432	0	0
	(33)	1114	13	4	(34)	7341	15	0
	(35)	983	11	8				

Sec.		£	s.	d.		£	s.	d.
6	(36)	453	6	8	(37)	8084	0	0
	(38)	1030	5	0	(39)	620	2	0
	(40)	304	3	4	(41)	5992	0	4
7	(42)	820	3	0	(43)	2024	9	0
	(44)	988	3	6	(45)	1768	8	6
8	(46)	1067	5	2¼	(47)	3981	8	4¼
	(48)	2232	13	9	(49)	12318	1	6
9	(50)	103684	8	10½	(51)	54647	2	10½
	(52)	5724	0	0	(53)	3891	15	4
10	(54)	20	4	7½	(55)	270	17	2¼
	(56)	78	16	1½	(57)	200	16	3
11	(58)	15387	15	0	(59)	2017	2	6
	(60)	57	2	7¼	(61)	27	1	1¼
12	(62)	438	15	0	(63)	107	9	10⅓
	(64)	4986	13	4	(65)	4217	12	6
13	(66)	25	7	11¼	(67)	6	14	1¾
	(68)	266	12	0	(69)	981	1	1⅓
14	(70)	853	13	0	(71)	5136	19	6
	(72)	40	17	3	(73)	12	4	4½
15	(74)	17	3	10¼	(75)	53	2	6¼
16	(76)	217	3	9	(77)	9646	19	8¾
17	(78)	313	10	3¼	(79)	10237	1	4¾
18	(80)	3370	15	7¾	(81)	13166	15	11
19	(82)	25	2	5⅓	(83)	33	14	1⅝
20	(84)	159	13	10⅓	(85)	2413	0	8$\frac{8}{9}$
21	(86)	1509	0	1⅓	(87)	899	9	1¾

See Example 8, page 116.

Sec.		£	s.	d.		£	s.	d.
22	(88)	88	5	8¼	(89)	316	11	11
23	(90)	159	18	11⅓	(91)	61	6	10¾
	(92)	248	19	9⅓				
24	(93)	130	17	4	(94)	475	5	3½
	(95)	1830	17	7	(96)	1997	18	0¼
25	(97)	3851	9	10¾	(98)	91	1	0¾
	(99)	19	1	3¼	(100)	2051	13	10
	(101)	412	10	1				

ANSWERS TO PROPORTIONAL PARTS.

Sec.

1 (1) 30, 45, 50, 65

(2) 27, 45, 63, 81

(3) 99, 117, 153

2 (4) 1570, 2826, 4082, 4710, 5652

(5) 198, 243, 288, 378, 468

(6) 450, 475, 600, 700, 1250

3 (7) 1152, 1728, 2624

(8) 644, 736, 1428

(9) 1248, 1536, 2040

4 (10) 256, 288, 160, 224, 480, 736

(11) 475, 551, 741, 855, 988, 1368

(12) 504, 522, 612, 3024, 3642, 4248

See Example 14, page 121.

5 (13) 18*l.*, 16*l.*, 14*l.*

(14) 1350*l.*, 2592*l.*, 2955*l.*

(15) 180*l.*, 135*l.*, 108*l.*

6 (16) 48 oz. 18 car.

(17) 27 ox., 18 sul.

(18) $19\frac{13}{17}$ h., $92\frac{4}{17}$ n.

7 (19) $497\frac{7}{8}$ lb. ox., $1742\frac{1}{8}$ lb. iron

(20) $2\frac{22}{29}$ cwt. ox., $7\frac{7}{29}$ cwt. iron

(21) $67\frac{281}{357}$ lb. O, $268\frac{76}{357}$ lb. Cu.

(22) $1\frac{203}{357}$ cwt. O, $2\frac{154}{357}$ cwt. Cu.

8 (23) $1\frac{408}{1117}$ lb. O, $17\frac{709}{1117}$ Pb.

(24) 15 cwt. nitre, 2 cwt. sul., 3 cwt. charcoal

(25) $255\frac{9}{25}$ lb. silicia, $50\frac{2}{5}$ lb. potash, $26\frac{22}{25}$ lime, $3\frac{9}{25}$ alumina

9 (26) 13365, 13860, 14175, 14553

(27) 1 oz, 8 dwt. $6\frac{6}{133}$ gr. pure gold, 2 dwt. $13\frac{127}{133}$ gr. alloy.

(28) 2*l.* 11*s.* $7\frac{11}{37}$*d.*, 2*l.* 9*s.* $3\frac{1}{3}$*d.*, 2*l.* 6*s.* 10[illegible]*d.*, 1*l.* 3*s.* 5[illegible]*d.*, 18*s.* $9\frac{5}{37}$*d.*

A and B engage in trade, their capitals being in the ratio of 4 to 5; and at the end of three months they draw respectively $\frac{2}{3}$ and $\frac{3}{4}$ of their capitals: how should they divide their whole gain, 335*l.*, at the end of the year?—*From Colenso's Arithmetic.*

Let A's capital be 1, then B's will be $\frac{5}{4}$.

A's capital in trade is 1 for 3 months = 3 for 1 month.

A's capital in trade is $\frac{1}{3}$ for 9 months = 3 for 1 month.

Then, A's capital in trade is 6 for one month.

B's capital in trade is $\frac{5}{4}$ for 3 months = $3\frac{3}{4}$ for 1 month.

B's capital in trade is $\frac{5}{4} - \frac{5}{4} \times \frac{3}{4} = \frac{5}{16}$ for 9 months = $2\frac{13}{16}$ for 1 month.

Then, B's capital in trade is $6\frac{9}{16}$ for 1 month.

Therefore, the gain, 335*l.*, must be divided in the ratio of 6 and $6\frac{9}{16}$.

$$\frac{6 \times 335}{12\frac{9}{16}} = 160l., \text{ the value of A's share.}$$

$$\frac{6\frac{9}{16} \times 335}{12\frac{9}{16}} = 175l., \text{ the value of B's share.}$$

Sec.

10 (29) A's = 196*l.* 17*s.* $11\frac{3}{4}\frac{33}{179}$*d.*;
B's = 162*l.* 0*s.* $4\frac{1}{4}\frac{55}{179}$*d.*;
C's = 648*l.* 1*s.* $7\frac{1}{4}\frac{41}{179}$*d.*

(30) 224, 240, 250

(31) 5720, 5616, 6006, 6336

11 (32) 13, 26, 78, 351

(33) 315, 378, 405.

ANSWERS TO QUESTIONS IN SQUARE AND CUBE ROOTS.

Horner's Method of Extracting Square and Cube Roots.

SQUARE ROOT.

For generality, simplicity, and certainty, Horner's method of extracting roots of all kinds is the best which has been hitherto discovered.

Extract the square root of 31685641.

	Root.
0	31′68′56′41 (5629
5	25
5	
5	
100	668
6	636
106	
6	
1120	3256
2	2244
1122	
2	
11240	101241
9	101241
11249	

Divide the given number into periods of two figures each, and place zero a little to the left of the given number.

Find the nearest root, which is 5 in this case, to the first period, place the 5 under the zero, and add, the sum being of course 5. Multiply this by 5, the figure in the root, and place the product under the first period. Now return and place 5 under 5, then draw the long line and add the two 5's together, and subtract the period; the result of these two operations will be 10 in the first case and 6 in the second.

Place a zero on the right side of 10, and bring down the next period 68, and proceed exactly in the same way with this period as in the first, except in finding the next figure in the root. This is done by dividing 668 by 100 or 66 by 10. In the next period the figure in the root is obtained by dividing 3256 by 1120, or 325 by 112, or 32 by 11.

Sec.			
1	(1) 62	(2) 73	(3) 90
	(4) 115	(5) 108	
2	(6) 88	(7) 176	(8) 199
	(9) 255	(10) 981	
3	(11) 989	(12) 1056	(13) 1254
	(14) 1614	(15) 2055	
4	(16) 2334	(17) 2965	(18) 2915
	(19) 2995	(20) 2885	
5	(21) 3629	(22) 5037	(23) 5006
	(24) 6340	(25) 8345	
6	(26) 4309	(27) 5434	(28) 6449
	(29) 7348	(30) 8749	
7	(31) 5849	(32) 6646	(33) 7548
	(34) 8185	(35) 9648.	

CUBE ROOT.

Extract the cube root of 630525109375.

		Root.
0	00	630'525'109'375(8575
8	64	512
8	64	
8	128	
16		
8		
240	19200	118525
5	1225	102125
245	20425	
5	1250	
250		
5		
2550	2167500	16400109
7	17899	15297793
2557	2185399	
7	17948	
2564		
7		
25710	220334700	1102316375
5	128575	1102316375
25715	220463275	

Divide the given number into periods of three figures each, and place one zero and two zeros to the left of the given number as indicated above. Find the nearest cube root, which is 8 in this case to the first period, place the 8 under the first zero and add, the sum is 8, multiply this sum by 8, the root, and place the product under the two zeros and add, the sum being 64, multiply this sum by 8, the root, and place the product under the first period. Return, and place the root 8 under the 8 in the first column, and add, the sum being 16, multiply this sum by 8, the root, and place the product under 64 in the second column. Return again and place 8, the root, under 16 in the first column, and then draw the long line. Add in the first and second columns, the sums are 24 and 192, and subtract in the third, the difference is 118; bring down the next period 525, and place two zeros to the right of 192, and one zero to the right of 16, and proceed exactly in the same way with this and the succeeding periods as in the first; except in finding the next following figures in the roots. The next figure 5 in the root is obtained by dividing 118525 by 19200, or 11852 by 1920, or 1185 by 192, or 118 by 19. The next figure is found by dividing 164 by 21, &c.

In extracting the square and cube roots of decimals, the student should be cautioned in dividing the given number into periods—always commence at the decimal point, and divide the number into periods in both directions.

Sec.			
8	(36) 76	(37) 87	(38) 65
	(39) 98	(40) 116	
9	(41) 165	(42) 629	(43) 807
	(44) 730	(45) 795	
10	(46) 803	(47) 885	(48) 997
11	(49) 1242	(50) 1259	(51) 1335
12	(52) 2056	(53) 2955	(54) 2999
13	(55) 2995	(56) 4645	(57) 6647
14	(58) 7348	(59) 8248	(60) 9942

SQUARE AND CUBE ROOTS.

Sec.		
15	(61) 2·56378; 1·87321	(62) 4·34856; 2·66418
	(63) 5·565; 3·1403	
16	(64) 23·6516; 8·23962	(65) ·15459; ·28804
	(66) 30·45472; 9·7523	
17	(67) 6·9199; 3·6313	(68) 19·1875; 7·16713
	(69) 2·02088; 1·59843	

Sec.		
18	(70) ·1538; ·2864	(71) ·0691592; ·168487
19	(72) 1·11803; 1·07722	(73) ·77459; ·84343
20	(74) ·60697; ·71688	(75) ·62017; ·72723
21	(76) 2·77746; 1·9759	(77) 2·23166; 1·70773
22	(78) 3·04676; 2·10164	(79) ·28476; ·432883
23	(80) ·075968; ·17936	(81) 6·99968; 3·6592
24	(82) ·047895; ·1319	(83) ·12586; ·25114
25	(84) ·64549; ·7469	(85) ·251688; ·39863
26	(86) ·774597; ·84343	(87) ·081378; ·187791
27	(88) ·028421; ·081859	(89) 1·74855; 1·44863
28	(90) ·4629; ·5984	(91) 1·3093; 1·1968

The fourth root of any number is obtained by extracting the square root of the number twice.

Extract the fifth root of 28153056843.

```
1st col.  2nd col.  3rd col.   4th col.      5th col.            root.
   0         00       000        0000        2'81530'56843(123
   1          1         1           1        1
  ---       ---       ---        ----
   1          1         1           1
   1          2         3           4
  ---       ---       ---
   2          3         4
   1          3         6
  ---       ---
   3          6
   1          4
  ---
   4
   1
---------------------------------------------------------
  50       1000     10000       50000        181530
   2        104      2208       24416        148832
  ---      ----     -----       -----
  52       1104     12208       74416
   2        108      2424       29264
  ---      ----     -----
  54       1212     14632
   2        112      2648
  ---      ----
  56       1324
   2        116
  ---
  58
   2
------------------------------------------------------------------
 600     144000   17280000   1036800000   3269856843
   3       1809     437427     53152281   3269856843
 ---     ------   --------   ----------
 603     145809   17717427   1089952281
```

Divide the given number into periods of five figures each, and place 1, 2, 3, and 4 zeros respectively to the left of the given number as indicated above.

Find the nearest fifth root, which is 1 in this case, to the first period; place the 1 under the first zero and add, the sum is 1; multiply this sum by 1, the root, and place the product under the two zeros and add, the sum is 1 ; multiply this sum by 1, the root, and place the product under the three zeros and add, the sum is 1 ; multiply this sum by 1, the root, and place the product under the four zeros and add, the sum is 1 ; multiply this sum by 1, the root, and place the product under the first period.

Return to the first column and place the root, 1, under the 1 and add, the sum is 2 ; multiply this sum by 1, the root, and place the product, 2, in the second column and add, the sum is 3 ; multiply this sum by 1, the root, and place the product, 3, in the third column and add, the sum is 4 ; multiply this sum by 1, the root, and place the product, 4, in the fourth column.

Return to the first column and place the root, 1, under the 2 and add, the sum is 3 ; multiply this sum by 1, the root, and place the product, 3, in the second column and add, the sum is 6 ; multiply this sum by 1, the root, and place the product, 6, in the third column.

Return again to the first column and place the root, 1, under the 3 and add, the sum is 4 ; multiply this sum by 1, the root, and place the product, 4, in the second column.

Return again to the 1st column and place 1, the root, under 4, and then draw the long line.

In the 1st, 2nd, 3rd, and 4th columns add, the sums are 5, 10, 10 and 5 respectively, to the right of which annex 1, 2, 3, and 4 zeros. In the 5th column subtract and bring down the next period, 81530. The same process must be repeated, except in finding the next figure in the root. This is done by dividing 181530 by 50000, or 181 by 50. The next figure is obtained by dividing 3269856843 by 1036800000, or 326 by 103.

If the cube root and square root of a number be extracted, the result is not the fifth but the sixth root. And by extracting the square root of any number twice, the fourth root is obtained ; but if the cube root be extracted twice, the ninth, and not the sixth root, is the result.

ANSWERS TO DUODECIMALS, OR CROSS MULTIPLICATION.

Sec.		Ft.	in.	′	″	‴		Ft.	in.	′	″	‴
1	(1)	18	4	0	0	0	(2)	71	6	4	0	0
	(3)	97	3	0	0	0	(4)	113	7	6	0	0
2	(5)	2229	6	6	0	0	(6)	2086	9	3	0	0
	(7)	1760	9	10	0	0	(8)	1319	3	4	5	0
3	(9)	252	6	2	11	0	(10)	455	7	11	10	6
	(11)	1159	7	4	3	3	(12)	2458	6	10	10	5
4	(13)	2767	3	7	9	8	(14)	24643	2	6	5	8
	(15)	28928	7	1	4	3						
5	(16)	8876	10	11	10	4	(17)	1029	1	9	8	1
	(18)	2997	10	3	6	4						
6	(19)	7132	0	5	3	9	(20)	748	6	3	8	3
	(21)	898	9	7	5	4						
7	(22)	4868	9	3	7	8	(23)	12062	5	9	10	5
	(24)	1404	10	0	3	9						
8	(25)	1791	9	3	3	9	(26)	18752	4	1	1	0
	(27)	33678	8	8	10	11						

							£	s.	d.
9	(28)	1520	9	11	4	6;	98	4	5
		614	5	1	3	4;	42	4	10
10	(29)	196	1	6	7	5;	15	2	4¼
	(30)	492	1	6	2	3;	32	16	2
11	(31)	23767	11	9	4	0;	470	8	1¾
	(32)	436	7	3	10	2;	2	14	6¾
12	(33)	30	7	5	1	10;	1	19	6½
	(34)	1027	10	1	2	8;	6	8	5¾
13	(35)	237	5	3	9	4;	43	0	8¾
14	(36)	741	10	10	7	9;	47	2	10
	(37)	3912	0	0	4	0;	138	11	0

ANSWERS TO MISCELLANEOUS EXAMPLES.

Sec.

1 (1) $2\frac{539}{3488}$ (2) 6*s.* $8\frac{3}{4}\frac{1}{13}$*d.*

(3) $3\frac{43}{192}$ (4) 142

(5) 1*l.* 3*s.* $6\frac{1}{2}$*d.* (6) 2·6754*l.*

(7) $2\frac{4}{5}$ days. (8) 801*l.* 6*s.* 9*d.*

(9) 9070*l.* 14*s.* 3*d.* (10) 1*l.* 15*s.* 10*d.*

(11) 25*l.* 13*s.* 9*d.* ; 17*l.* 2*s.* 6*d.* ; 12*l.* 16*s.* $10\frac{1}{2}$*d.*

(12) 2379 (13) 2879

(14) $41\frac{1}{7}$ (15) 43*l.* 16*s.* 5*d.*

(16) $4\frac{1}{4}$ per cents., 4*l.* 10*s.* 11*d.*

(17) $4\frac{1}{2}$

2 (1) $\frac{39}{128}$ (2) $\frac{19}{250}$

(3) ·314 (4) 2*l.* 7*s.* $1\frac{1}{2}$*d.*

(5) 3·7916 (6) 27 days

(7) 1096*l.* (8) 504*l.* ; 441*l.* ; 892*l.*

(9) 21*l.* 5*s.* $6\frac{1}{4}$*d.* (10) ·9446

(11) $77\frac{1}{7}$ (12) 1*l.* 3*s.* $6\frac{3}{4}$*d.*

(13) 20*l.* 3*s.* 5*d.* (14) $4\frac{4}{5}$

3 (1) 270*l.* (2) $5\frac{1}{2}$ hours

(3) $7\frac{797}{1204}$ (4) $3\frac{127}{175}$

(5) $\frac{29}{32}$ (6) ·00000428, &c.

(7) 18*s.* $1\frac{3}{4}$*d.* (8) ·5773

(9) ·5848

(10) 104*l.* 10*s.* 0*d.* ; 139*l.* 6*s.* 8*d.* ; 174*l.* 3*s.* 4*d.* ; 209*l.*

(11) $8\frac{1}{4}\frac{12}{25}$*d.* (12) 482*l.* 19*s.* $2\frac{1}{4}$*d.*

(13) $23\frac{1}{18}$ (14) 2*l.* 14*s.* $10\frac{1}{2}$*d.*

(15) Increased 4*l.* 13*s.* $9\frac{3}{5}$*d.* (16) $3\frac{3}{4}$

Sec.

4 (1) 11s. $7\frac{1}{4}\frac{1}{27}$d. (2) $\frac{175}{222}$

(3) 134 (4) ·2476

(5) 1 ton. 12 cwt. 0 qrs. 22 lbs.

(6) $2\frac{1}{10}$ (7) 1249l. 4s.

(8) ·4629 ; ·6650 (9) $3\frac{1}{2}\frac{1}{48}$

(10) Apprentices = 6l. ;
Men = 48l. ;
Officers = 160l.

(11) A = 36 ;
B = 30 ;
C = 45.

(12) 1l. 17s. $1\frac{1}{2}$d. (13) Lost 24l. 0s. $8\frac{1}{4}$d. (14) $2\frac{3}{4}$

5 (1) $83\frac{3}{5}$ (2) $\frac{1}{12}$

(3) 7 t. 6 cwt. 2 qrs. 18 lb. 10 oz. $10\frac{2}{3}$ drs.

(4) 1.3 (5) 131·608

(6) 5 cwt. 0 qrs. 5 lb. 2 oz. 7 drs.

(7) 3·17536 (8) 6 lb. 4 oz.

(9) $942\frac{6}{7}$l. (10) 16s. $6\frac{3}{4}$d.

(11) 5 per cents. ; 13s. $10\frac{7548}{16285}$d. per cent.

(12) 1062l. 18s. $9\frac{1}{4}$d. (13) ·51299

(14) ·86376 (15) 26s. 0[illegible]d. ; $3480\frac{20}{31}$

		£	s.	d.
(16)	A =	279	19	$11\frac{1}{2}$
	B =	291	16	$8\frac{3}{4}$
	C =	1231	3	$8\frac{1}{2}$
	D =	1663	19	$7\frac{1}{2}$

(17) 638l. 7s. $8\frac{1}{2}$d. (18) 9670 ft. 1 in. 8′ 1″

(19) 16

6 (1) 1 (2) 3 cwt. 1 qr. 23 lb. 2 oz. $9\frac{1}{81}$d.

(3) $\frac{3}{17}$ (4) ·493096

(5) 5·2407 (6) ·557903

(7) ·345 (8) $51\frac{2}{3}$

Sec.

6 (9) $57\frac{1}{7}$ years. (10) 504*l.* 11*s.* $3\frac{3}{4}$*d.*

(11) ·8612 (12) 1·4466

(13) 21*s.* $4\frac{28}{43}$*d.*

(14) 1288*l.* 16*s.*; 2148*l.*; 3007*l.* 4*s.*

(15) 1187*l.* 13*s.* $8\frac{3}{4}$*d.* (16) 20*l.* 16*s.* 10*d.*

(17) 24*l.* 7*s.* $2\frac{1}{2}$*d.* (18) $9\frac{207}{217}$

7 (1) $\frac{4}{7}$ (2) $1\frac{67}{304}$

(3) 2*s.* $5\frac{1}{4}\frac{9}{11}$*d.* (4) 4·0657552083′

(5) ·000903 (6) 14*l.* 18*s.* 1*d.*

(7) 1·9887 (8) 66*l.* 3*s.* $4\frac{1}{4}$*d.*

(9) 1·2747; 1·1756 (10) 844*l.* 14*s.* $8\frac{1}{4}$*d.*

(11) 2 lb. 7 oz. 3 dr. (12) $42\frac{2}{19}$ years.

(13) 331*l.* 4*s.* $4\frac{4}{83}$*d.*

(14) A = 1*l.* 16*s.* 3*d.*;
B = 2*l.* 4*s.* $10\frac{1}{2}$*d.*;
C = 2*l.* 14*s.* $4\frac{1}{2}$*d.*

(15) $8\frac{28}{55}$, 4000 (16) 382*l.* 12*s.* $10\frac{3}{4}$*d.*

(17) $1\frac{17}{42}$ hours. (18) 24*l.* 13*s.* $7\frac{1}{4}$*d.*

(19) 4*l.* 12*s.* 10*d.*

(20) A = $18\frac{1320}{1567}$;
B = $23\frac{297}{415}$;
C = $35\frac{1748}{2481}$.

8 (1) $\frac{1}{18}$ (2) $\frac{36}{17}$

(3) 1 ton. 1 cwt. 2 qr. 3 lbs. $1\frac{7}{8}$ oz.

(4) ·8181 (5) ·5241354

(6) 9 cwt. 3 qr. 24 lb. 15 oz. 2 dr.

(7) 1·4664 (8) 1954*l.* 12*s.* $5\frac{3}{4}$*d.*

(9) 7·4077; 3·8000 (10) 429*l.* 15*s.* $3\frac{1}{4}$*d.*

(11) 1 m. 1 w. 2 d. 18 h. 20 m. (12) 1137*l.* 15*s.* $6\frac{1}{2}$*d.*

(13) $8\frac{1}{2}$ years.

(14) A = 1407*l.* 19*s.* $3\frac{1}{4}$*d.*;
B = 1877*l.* 5*s.* $8\frac{1}{2}$*d.*;
C = 2393*l.* 10*s.* $9\frac{1}{4}$*d.*

Sec.

8 (15) 18*s.* $6\frac{3}{40}$*d.* (16) 676*l.* 11*s.* $5\frac{1}{2}$*d.*
(17) $14\frac{13}{40}$ (18) 11*l.* 8*s.* $5\frac{12}{313}$*d.*
(19) 269*l.* 10*s.* 6*d.*

9 (1) 8 (2) $\frac{13}{9}$
(3) 2 a. 1 r. 24 p. (4) ·908389
(5) ·0325438 (6) 1 r. 38 p. 14 y.
(7) ·3276 (8) 14755*l.* 15*s.* $1\frac{1}{2}$*d.*
(9) ·2161 ; ·3601 (10) $6\frac{2}{35}$
(11) $1\frac{52}{55}$ months. (12) 858*l.* 4*s.* $0\frac{11}{485}$*d.*
(13) $5\frac{1}{4}$ years.
(14) Captain = 371*l.* 5*s.* ;
Inferior Officer = 148*l.* 10*s.* ;
Man = 16*l.* 17*s.* 6*d.*
(15) 2208*l.* 3*s.* $2\frac{3}{4}$*d.* (16) 12*l.* 18*s.* $2\frac{1}{2}$*d.*
(17) A = $12\frac{36}{67}$;
B = $15\frac{45}{53}$;
C = $49\frac{7}{17}$.
(18) 14*s.* 4*d.* per cent. in favour of $4\frac{1}{2}$ per cents.
(19) 2201*l.* 2*s.* 9*d.*

10 (1) $\frac{3}{8}$ (2) $\frac{5}{8}$
(3) 10 oz. 10 dwt. (4) 1·41589
(5) 1·21064 (6) 4 oz. 16 dwt. 20 gr.
(7) 8·99551 (8) 19182*l.* 8*s.* 6*d.*
(9) 2·9099 ; 2·0382 (10) $2\frac{11}{36}$
(11) $206\frac{2}{3}$ (12) $6\frac{1}{3}$ years.
(13) 556*l.* 16*s.* $10\frac{2}{19}$*d.*
(14) Man = 42*l.* 15*s.* ;
Apprentice = 14*l.* 5*s.*
(15) 4149*l.* 10*s.* $2\frac{1}{4}$*d.* (16) 15*l.* 17*s.* $10\frac{1}{4}$*d.*
(17) $36\frac{12}{81}$ (18) 453*l.* 12*s.* $6\frac{3}{4}$*d.*
(19) 514*l.* 18*s.* 11*d.*

ANSWERS TO EXAMPLES ON LOGARITHMS.

Sec.			
1	(1) 22·2284	(2) 27·4705	(3) 299·434
	(4) 514·552	(5) 79·1949	(6) 495·65
2	(7) 2447·35	(8) ·52688	(9) 34208·2
	(10) 1303·06	(11) 427·737	(12) ·00163[illegible]
3	(13) 10·[illegible]	(14) ·549223	(15) 0·02404
	(16) 457·493	(17) 5·9842	(18) 5·81[illegible]
4	(19) 22·83896	(20) 9·858046	(21) 1190·26
	(22) 16245·74	(23) 4·063364	(24) ·01847583
5	(25) 16·3612	(26) ·345657	(27) 1569·43
6	(28) 1054·[illegible]	(29) ·2177763	(30) 2·38504
7	(31) 970·696	(32) 2·00704	(33) 1357·3
	(34) 9·02308	(35) 31·0065	(36) 138·8874
8	(37) 15·01562	(38) ·434645	(39) ·3574378
	(40) 1·74854	(41) 2·09758	(42) 1·26216
9	(43) ·448294	(44) 1·007662	(45) 1·71944
10	(46) 1·29656	(47) 5·408015	(48) 1·64811
11	(49) 18·7895	(50) 1·9198	(51) 4·2227
12	(52) 3·85129	(53) 2225·54	(54) 4·[illegible]33
13	(55) ·[illegible]	(56) 37·8944	(57) ·000471843
	(58) 7·084055	(59) ·101847	(60) 417·449
14	(61) ·883194	(62) ·23807	(63) 1·11962
15	(64) 96·7417	(65) 13·0299	(66) 1·[illegible]
	(67) 25·42675	(68) 2·93787	(69) 149·657
16	(70) ·309065	(71) 184600·7	(72) 1·45556
17	(73) 6·0892	(74) 5·[illegible]	(75) 4·87071
18	(76) ·3597854	(77) 4·37045	(78) ·91644
19	(79) 1·10071	(80) ·073421	(81) ·14217946
20	(82) 333·084	(83) 18·2529	(84) 1·31812

ANSWERS TO APPENDIX.

EXAMINATION PAPER, No. 1.

Sec. £ s. d. t. cwt. q. lb. oz.
1 (1) 65 5 $11\frac{1}{2}$ [illegible] (2) 128907 (3) 8 17 1 20 13
(4) $35\frac{1}{7}$

2 (1) 14 (2) 1404 (3) $\frac{3}{5}$
(4) $\frac{19}{77}$ (5) 990·042 (6) 5*s.* $5\frac{3}{5}$*d.*

£ s. d.
3 (1) 5 (2) 46 13 $10\frac{1}{4}$ (3) $7\frac{1}{4}$
(4) ·8625 ; ·9027 (5) 846 6 7·8 3

£ s. d. £ £
4 (1) 8 days. (2) 11 16 $10\frac{2}{15}$ (3) 21 ; 35
£ s. d. £ s. d. d.
(4) 41 13 4 (5) 833 6 8 ; 10

EXAMINATION PAPER, No. 2.

Sec. t. cwt. q. lbs. oz. lbs. oz. dwt. gr.
1 (1) 2 5 1 19 $2\frac{482}{583}$ (2) 60 0 3 7
£ s. d.
(3) 23 1 $3\frac{111}{1288}$ (4) $16\frac{1}{34}$

2 (1) 3 (2) $\frac{1}{2}$ way round ; 1080 days (3) $\frac{8}{27}$
s. d.
(4) $\frac{7}{9}$ (5) 2 4·1988

3 (1) 90 men (2) $3\frac{1}{2}$
£ s. d. £ s. d.
(3) 3 12 ·4 (4) ·78624 ; ·85186 (5) 2 9 ·4 nearly.

4 (1) $6\frac{22}{125}$ (2) $3\frac{222}{259}$
lbs. lbs. lbs. lbs.
(3) $144\frac{16}{31}$; $14\frac{14}{31}$; $9\frac{1}{31}$. (4) $661\frac{1}{4}$

EXAMINATION PAPER, No. 3.

Sec.

1 (1) $123\frac{1}{3}$ — (2) 3 lbs. 7 oz. 0 dwt. $13\frac{20}{37}$ gr.
(3) 7, 9, 11 times; 1386 — (4) $12\frac{2}{11}$

2 (1) $\frac{2}{3}$ — (2) $\frac{2}{9}$
(3) 11 s. $0\frac{3}{4}$ d. ·027 — (4) 19 s. $0\frac{3}{4}$ d. ·$\frac{21}{25}$

3 (1) $16\frac{1}{3}$ — (2) $3\frac{1}{3}$ years.
(3) £17 1 s. 0 $\frac{86}{217}$ d. — (4) ·42008; ·56091 — (5) £30 14 s. $1\frac{1}{4}$ d.

4 (1) 63; $18\frac{2}{3}$; $14\frac{2}{3}$ days. — (2) £1134 17 s. 11 $\frac{5}{787}$ d.
(3) £313 7 s. 0 $\frac{258}{287}$ d. each officer at £240; £522 5 s. 1 $\frac{88}{287}$ d. each officer at £400; £848 13 s. 3 $\frac{177}{287}$ d. (4) £330 9 s. 1 $\frac{401}{2871}$ d.

EXAMINATION PAPER, No. 4.

Sec.

1 (1) 85149325 — (2) £1277 5 s. $4\frac{1}{2}$ d.
(3) $14\frac{2}{3}$ days; 45, 15, 60, and 30 miles from the starting point.
(4) 64 a. 3 r. 25 p. $10\frac{3}{4}$ yds.

2 (1) 2 r. 26 p. $20\frac{1}{6}$ yds. — (2) $\frac{59}{192}$
(3) £1 1 s. $1\frac{1}{2}$·66 d. — (4) 3248 fr. 2 c. 9 m.

3 (1) 369 men — (2) $4\frac{1}{2}$ — (3) 1·21267
(4) £16 10 s. $6\frac{3}{4}$ d. — (5) $13\frac{377}{891}$ years.

4 (1) £14; £135 — (2) £700 stock. — (3) £1007 $\frac{281}{287}$ stock.
(4) 50 minutes $34\frac{2}{7}$ seconds past 10 o'clock.

EXAMINATION PAPER, No. 5.

(1) $\frac{43}{47}$ and $\frac{1}{7}$; $\frac{3}{8}$; $\frac{15}{32}$

(2) Men £1 3s. 4d., appren. 16s. 8d.

(3) £35 11s. $6\frac{3}{4}$d.

(4) £3 18s. $3\frac{3}{32}$d. in favour of 4 per cents.

(5) $14\frac{3}{5}$ days — 45, 15, 60, 30, and 0 miles from the starting point.

(6) £13 9s. $2\frac{1}{4}$·744d.

EXAMINATION PAPER, No. 6.

(1) $\frac{27}{16}$; $\frac{3}{2}$; $\frac{7}{8}$; $\frac{10}{7}$.

(2) 27735*d.* Flemish gain.

(3) $472\frac{41}{122}$; $59\frac{26}{61}$; $444\frac{41}{61}$; $23\frac{69}{122}$ tons.

(4) $634\frac{58}{63}$ stock.

EXAMINATION PAPER, No. 7.

(1) $$4+\cfrac{1}{7+\cfrac{1}{1+\cfrac{1}{3+\cfrac{1}{1+\cfrac{1}{16+\cfrac{1}{1+\cfrac{1}{1+\cfrac{1}{15}}}}}}}}$$

Convergents.

$$\frac{4}{1};\ \frac{29}{7};\ \frac{33}{8};\ \frac{128}{31};\ \frac{161}{39};\ \frac{2704}{655};\ \frac{2865}{694};\ \frac{5569}{1349}.$$

(2) 909 lbs. 4 oz. $14\frac{48}{101}$ dr. ; 266 lbs. 2 oz. $3\frac{49}{101}$ dr. ; 1064 lbs. 8 oz. $13\frac{25}{101}$ dr.

(3) £356 11s. $7\frac{11}{191}$d.

(4) $5\frac{55}{424}$ miles.

(5) ·70949

EXAMINATION PAPER, No. 8.

	cwt.	qr.	lb.	oz.	dr.
(1)	6	2	17	7	8·832

(2) $34\frac{1}{4}$ days.

(3) $\frac{907}{18564}$; $\frac{1}{20}$; $\frac{2}{41}$; $\frac{15}{307}$; $\frac{77}{1576}$; $\frac{169}{3459}$; $\frac{248}{5055}$.

(4) $10\frac{10}{11}$ min. past 2 o'clock.   (5) 8, 23, 1.

EXAMINATION PAPER, No. 9.

(1) 5   (2) 196 tons.

(3) 337·998 lbs. $18\frac{1}{2}$ mass.   (4) $766\frac{3}{7}$ lbs. $23\frac{1}{8}$ mass.

(5) 419·39   (6) 180

(7) 20·12   (8) 129·58

(9) 768 lbs.   (10) 1878·8 lbs.

(11) 17244·6   (12) $2\frac{1}{2}$ lbs.

13) 1327·21 lbs.   (14) 5534·2

(15) 154 tons nearly.

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